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# REM IV

Remedial Planning Activities
at Selected Uncontrolled
Hazardous Waste Sites–Zone II

Environmental Protection Agency
Hazardous Site Control Division
Contract No. 68-01-7251

DRAFT
SAN GABRIEL
SUPPLEMENTAL SAMPLING PLAN
REPORT

VOLUME 1 of 3 - TEXT
SAN GABRIEL BASIN
LOS ANGELES, CALIFORNIA
WA 105.9L27.1

May 19, 1986

CH2M HILL

Black & Veatch
ICF
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## EXECUTIVE SUMMARY

The results of the San Gabriel Supplemental Sampling Program (SSP) are presented in this report. The SSP report contains six sections and two appendices. The six sections include the following: Introduction, Site Description, Supplemental Sampling Program, Initial Screening of No-Action and Surface Water Supply Alternatives, Recommendations, and References. Appendix A presents the details of a hydrogeologic evaluation and analysis of the basin. Appendix B presents documentation of the sampling activities undertaken as part of the SSP and summarizes data collected in other sampling programs. Historical groundwater contamination data through about August 1985 are also given in Appendix B. This Executive Summary presents a brief summary of the first five sections of this report.

### SECTION 1.0 - INTRODUCTION

The San Gabriel SSP has been undertaken as part of the U.S. Environmental Protection Agency's (EPA's) response to groundwater contamination in the San Gabriel Basin under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, commonly referred to as Superfund. Groundwater contamination of the basin by volatile organic compounds, such as trichloroethylene (TCE), was first observed in December 1979 when water samples from Valley County Water District's Morada Street No. 3 well showed a concentration of 1,800 parts per billion (ppb). Since this time, the California Department of Health Services (CDHS) has sampled and has required water purveyors to sample their wells to assess the extent of contamination. By late 1984, 59 wells contaminated with TCE, perchloroethylene (PCE), and/or carbon tetrachloride (CTC) had been identified. The water purveyors operating these wells have been operating under an interim plan to take these wells out of production or blend the water with noncontaminated wells to maintain the contaminants below concentrations that may pose a risk to public health. The EPA is in the process of providing initial remedial measures for Richwood and Rurban Homes Mutual Water Companies, whose only available water wells have been contaminated. All other purveyors have been able to maintain contaminant levels below concentrations considered to pose a public health threat.

On January 1, 1984, a state law (AB 1803) went into effect requiring public water systems with more than 200 services to initiate a sampling program to evaluate the presence of organic chemical contaminants in the groundwater. The Upper San Gabriel Valley Municipal Water District and the San Gabriel Valley Municipal Water District have sponsored a program to sample 119 wells in the San Gabriel Basin. A report on the findings of this sampling program has been submitted to the CDHS, and these results have been made available to the EPA for inclusion in the SSP investigation.

The EPA has sponsored the San Gabriel SSP to compile and analyze available data on the hydrogeology and groundwater contamination of the basin and collect water samples from existing wells to further delineate the types and extent of contamination. These data are to be used in planning the Remedial Investigation/Feasibility Study (RI/FS), which will be undertaken to develop remedial actions for the groundwater contamination problems. The specific objectives of the San Gabriel SSP, which represents the initial tasks of the remedial investigation, include the following:

- Develop a centralized data base on the geology, hydrology, groundwater contamination, and groundwater utilization in the basin

- Develop a better understanding of groundwater conditions in the basin and factors controlling groundwater flow directions and rates

- Determine further the nature of contaminants in the groundwater in addition to TCE, PCE, and CTC

- Further assess the lateral and vertical extent of contamination

- Determine potential source areas of groundwater contamination

- Evaluate the rate and direction of groundwater movement from areas of contamination

- Conduct an initial assessment of the no-action alternative

- Conduct an initial evaluation of the feasibility of replacing contaminated groundwater with surface water supplies

- Provide recommendations for further work to be conducted during the RI/FS

The scope of the San Gabriel SSP has involved field, laboratory, and analytical activities to achieve the objectives of the SSP. These specific activities have included the following:

- Collection and compilation of available reports and data on geologic and hydrologic conditions, groundwater utilization, and groundwater contamination

- Review of the water analysis program for the Main San Gabriel Basin, prepared in response to AB 1803

- Development of a sampling plan to collect groundwater samples in coordination with the AB 1803 sampling program

- Collection of groundwater samples from 70 wells for the analysis of volatile and semivolatile organic compounds, selected agricultural chemical compounds, and selected contaminants believed to be related to potential sources of contamination

- Laboratory analysis of the collected groundwater samples through the EPA Contract Laboratory Program (CLP)

- Construction of a numerical three-dimensional groundwater flow model of the San Gabriel Basin

- Application of the model results to assess potential source areas of contaminants and assess the continued spreading rate of contaminants

- Evaluation of available groundwater contamination data including data collected as part of the AB 1803 program, the SSP and CDHS activities, to delineate the lateral and vertical extent of contaminants

- Preliminary assessment of the no-action alternative

- Preliminary assessment of the feasibility of replacing contaminated groundwater with surface water based on the quantity of groundwater historically produced from wells that are exceeding or have exceeded contaminant levels recommended by EPA and the State as acceptable, availability of a surface water supply, and cost of replacement water

- Identification of data gaps to be addressed in the RI/FS

## SECTION 2.0 - SITE DESCRIPTION

The San Gabriel Basin is located in the eastern portion of Los Angeles County. The San Gabriel Basin, as it is referred to throughout this report, is the "San Gabriel Valley Groundwater Basin" as defined by the California Department of Water Resources (CDWR, 1966). The basin is an alluvial valley bounded on the north by the San Gabriel Mountains; the bedrock high between San Dimas and La Verne on the east; and the Repetto, Merced, Puente, and San Jose Hills on the west and south. The 1980 census indicates that approximately one million people reside in the San Gabriel Valley.

The water-bearing formations underlying the basin are principally unconsolidated and partially consolidated nonmarine sediments of Recent and Pleistocene age. Marine sediments of probably Pleistocene age and marine sediments of late Pliocene age are included with the water-bearing formations. These water-bearing formations consist of gravel and boulders, and coarse sediments. These sediments range up to over 4,000 feet in thickness.

Groundwater movement in the San Gabriel Basin is generally from the perimeter of the basin toward the Whittier Narrows, which is the principal subsurface outflow of groundwater in the basin. Sources of groundwater include deep percolation of precipitation, percolation of surface water through streambeds, deep percolation of delivered water, artificial recharge at spreading basins, and subsurface inflow from adjacent basins. Groundwater leaves the basin by subsurface outflow (through Whittier Narrows), groundwater pumping, and groundwater discharge to rivers. At the major pumping centers located near West Covina and San Gabriel, water levels are lowered, forming cones of depression. Pumping has resulted in changes in the natural groundwater flow directions; and, in some cases, flow directions have reversed from the conditions observed in 1933.

## SECTION 3.0 - SUPPLEMENTAL SAMPLING PROGRAM

A total of 70 wells have been sampled under the San Gabriel SSP. This sampling has been undertaken for the following purposes:

- Quality Assurance Sampling - Seventeen of the wells sampled for the AB 1803 program were sampled simultaneously for the purpose of comparing results from the two programs.

- Source Sampling - Fourteen wells have been selected near potential source areas of contamination in the vicinity of Azusa. These 14 wells include eight of the wells sampled during the quality assurance sampling.

- General Sampling - Forty-seven wells have been sampled to aid in delineating the extent of known or suspected contamination.

The quality assurance sampling indicates the results of the AB 1803 sampling are comparable with the results of the SSP sampling. Contamination has been detected in 12 of the

17 wells sampled. Volatile organic compounds have been detected in 10 of the 17 wells.

The results of the source sampling indicate 10 wells have detectable levels of contamination. A total of 10 volatile and semivolatile compounds have been detected. Trichloroethylene is the most commonly occurring contaminant, and was detected in 6 of the wells. Trichloroethylene concentrations in the area range from one to 1,100 ppb. Other compounds, detected in relatively high concentrations, include perchloroethylene, 1,1,1,-Trichloroethane, and 1,1-Dichloroethylene.

Freon 113, Xylidene, hydrazine, perchlorate, selenium, thiourea, aniline, and N-nitrosodimethylamine have also been analyzed in the source sampling water samples. These contaminants have not been detected with the exception of Freon 113. Freon 113 has been detected in one well at a concentration of 10 ppb. The analytical procedure used for the perchlorate analysis has been determined to be inappropriate. Nitrate levels above one ppm cause positive interference of the perchlorate analysis. Nitrate levels in the groundwater are generally above one ppm in the areas sampled and range as high as 120 ppm. In addition, evaluation of the analytical procedure by the CDHS Southern California Laboratory determined that the presence of other ions also interferes with the perchlorate analysis. Therefore, the results of the perchlorate analyses were rejected in the quality assurance review of the laboratory results.

Pesticides and herbicides have also been analyzed as part of the source sampling program. This testing has been conducted because of the historical use of these compounds in the area. These contaminants have not been detected in the seven wells checked.

The general sampling results indicate detectable levels of contamination in 28 of the 47 wells sampled. A total of 10 volatile and semivolatile organic compounds have been detected. Trichloroethylene has been the most common contaminant found, ranging in concentration from one to 130 ppb in 16 of the 47 wells.

Perchloroethylene is the next most commonly occurring compound, ranging from one to 134 ppb in 12 wells. Volatile organic compounds have been detected in 25 wells, and semivolatile organic compounds have been detected in 7 wells. A total of 19 wells showed no detectable levels of contamination.

The results of the SSP, AB 1803 and CDHS sampling activities have been useful in further delineating the extent of organic contamination in the basin. A combined total of 195 wells have been sampled during the first 8 months of 1985. Based on sampling results obtained since 1979 and including the present results, a total of 88 wells has been identified as having contamination which has exceeded or is currently exceeding levels recommended by EPA or the State. Some of these wells have been taken out of service and others have exhibited a reduction in contaminant levels more recently. Sampling during 1985 has identified 58 wells which still exceed levels recommended by the EPA and/or the State.

Maps showing the extent of TCE, PCE, and CTC contamination in the basin are shown in Plates 1, 2, and 3. These plates show that previously known or suspected areas of contamination have been defined better as a result of the sampling in 1985; however, additional areas of contamination have been identified. These new areas of contamination will require further investigation to assess the areal and vertical extent of contamination and additional work remains on previously known areas of contamination.

A computerized data base has been developed to store, retrieve, analyze, and display groundwater contamination data. This data base contains historical data dating back to 1979 and extending through August 1985, although data are sparse after May 1985, when the SSP sampling activities were completed. Many of the water purveyors and the CDHS continue to sample wells in the basin as part of their ongoing monitoring activities. These data will be obtained for future investigation and entered into the data base.

A three-dimensional groundwater flow model has been developed for the San Gabriel Basin as part of the SSP activities. The model accounts for the following features:

- The geometry of the alluvial aquifer
- The spatial variation in the hydrogeologic properties of the alluvial aquifer
- The spatial and temporal variation in the magnitudes of recharge from precipitation, streambed percolation, and at spreading grounds
- Groundwater pumping
- Groundwater discharge to rivers
- Subsurface flow from adjacent basins

The model has been calibrated using available groundwater level data and water budget information for the period from the 1977-78 water year (October 1977 through September 1978) through June 1984. The calibrated model was used to produce groundwater level maps and to assess directions and rates of groundwater flow.

Regional groundwater flow velocities have been estimated for the period of simulation. Some seasonal variation in the groundwater flow field has been observed. However, an examination of these variations, and a comparison with directions and rates of groundwater flow calculated from actual water level maps from 1950 through 1982, lead to the conclusion that a time-averaged groundwater flow field based on the simulation period may be appropriate for making an initial assessment of potential source areas and the potential spread of contaminants which can be used for planning future investigations. Regionally averaged groundwater velocities appear to range from less than 100 feet per year in the extreme western portion of the basin, to over 1,000 feet per year in the eastern and north central portions of the basin. Throughout most of the south central portion of the basin, average groundwater velocities range from 100 to 500 feet per year. These velocities represent regional averages over sizable portions of the alluvial aquifer. Local variations from the average values, caused by aquifer heterogeneities, may be significant. These conditions will be evaluated in future refinements of the groundwater flow model.

A sensitivity analysis has been performed to evaluate the uncertainty in model input parameters on calculated groundwater flow rates. The greatest degree of uncertainty in the groundwater flow calculations is associated with estimates of effective porosity and the distribution of hydraulic conductivity.

The groundwater flow model results have been applied to assess potential source areas of contamination. Many contaminated wells have been analyzed, using an analytical model referred to as RESSQ (Javandel, et al., 1984), to assess the zone of capture for various contaminated wells. The results of this analysis have indicated a large number of areas which may be source areas of contamination. These areas have been categorized as having a high or moderate potential for containing sources of contamination. These potential source areas can be used with other data being compiled by the EPA on industries having used or disposed of contaminants in these areas, to prioritize areas for further source investigation activities.

The groundwater flow modeling results have also been used to evaluate the potential spread of contaminants in the basin. This analysis is based on an evaluation of groundwater flow from areas contaminated with TCE, PCE, and CTC. The effects of dispersion, retardation, degradation of contaminants, and contaminant sources have been neglected for this study; but these effects will be taken into consideration during the RI/FS. Based on an analysis of existing groundwater flow conditions, several small areas of contamination are expected to merge to form larger areas of contamination over the next 5 to 20 years if the status quo is maintained in the basin. Much of the contamination is expected to spread laterally up to several miles over the next 5 to 20 years. The results of this analysis will be useful in planning RI/FS activities.

## SECTION 4.0 - INITIAL SCREENING OF NO-ACTION AND SURFACE WATER SUPPLY ALTERNATIVE

Historical data, from late 1979 through about August 1985, indicate that 88 wells have previously shown or currently show contamination exceeding EPA's Proposed Maximum Contaminant Levels or State Action Levels for TCE, PCE, CTC, 1,1-Dichloroethylene (1,1-DCE) and/or 1,2-Dichloroethane (1,2-DCA). Further spreading of these contaminants in the groundwater may potentially affect over 90 more wells over the next 5 to 20 years. Present blending, discontinued use, and treatment of contaminated groundwater have been effective in maintaining contaminant levels in water supply systems below levels recommended by EPA and the State. However, as the contamination continues to spread, it will be difficult to assure an adequate water supply. Therefore, further planning, evaluation and implementation of remedial actions is needed to ensure an adequate supply of uncontaminated water.

Groundwater represents over 90 percent of the total water supply in the San Gabriel Basin. To date, a total of 88 wells have been affected by contamination above recommended contaminant levels either currently or at some time in the past. These 88 wells represent 33 groundwater users and approximately 33 percent of the total groundwater historically pumped by them, although not all of these producers are necessarily affected currently. Based on the 88 wells which have been affected historically, the average annual groundwater production represented by these wells is approximately 63,510 acre-feet, which is about 30 percent of the total groundwater production in the basin.

The only major new surface water supply which can be considered as an alternative water supply is water imported by the Metropolitan Water District of Southern California (MWD). An analysis of projected supply and demand conducted by MWD indicates potential water shortages within the next 10 years. The availability of MWD water for replacing contaminated groundwater water in the San Gabriel Basin is considered uncertain. The 1985-86 fiscal year price for untreated and interruptible water was $148 per acre-foot, which is expected to range from 2 to 4 times the cost of pumping groundwater. If all of the groundwater production that has exceeded acceptable levels of contamination was replaced with this water, the cost would be approximately $9.4 million annually in 1985 dollars. If an uninterruptible, treated supply of water is required, the cost of replacement water is estimated to be $14.2 million. The cost of MWD water is anticipated to escalate at a rate of approximately 10 percent per year over the next 5 years. These costs do not include the substantial capital costs for construction of connections to the MWD system and associated distribution facilities.

Based on the potential threat to the groundwater supply posed by the continued spread of contamination and the limitations of replacing groundwater with an alternate supply, a Remedial Investigation/Feasibility Study should be completed to identify and evaluate remedial alternatives to the contamination problem. It is anticipated that the RI/FS will take several years to complete due to the magnitude of the problem. The San Gabriel Basin is unique in comparison to most Superfund sites in terms of the areal extent and number of political entities that may be involved in the solution to the problem.

## SECTION 5.0 - RECOMMENDATIONS

The San Gabriel SSP has been successful in providing a better understanding of the organic contamination of groundwater in the basin. However, significant data gaps remain to be addressed in identifying parties responsible for the contamination and in identifying and developing cost-effective remedial actions. Recommendations for further response to groundwater contamination and areas to be addressed in the RI/FS are provided with regard to the following: monitoring, contaminant source investigation, further delineation of the extent of contamination including collection of additional hydrogeological data, and identification and screening of remedial action alternatives.

Monitoring of groundwater production should be initiated immediately and on a continuous basis for those wells located within the areas identified as having contaminants above federal standards and State guidelines. Wells downgradient of identified areas of contamination should be monitored on a regular basis, to be determined by its potential for future contamination. Continued monitoring of selected wells throughout the basin should be done to provide a record of contaminant concentration variation and for use in conducting the RI/FS.

The results of the source area investigation of the SSP should be combined with the results of other EPA source investigation activities to prioritize further source investigations. Refinement of the analysis of contaminant migration in the vicinity of source areas should be completed prior to the collection of field data in order to optimize the selection of data collection sites.

Additional areas of groundwater contamination have been identified as a result of the groundwater sampling performed in 1985. The areal extent of these new areas of contamination should be assessed. The CDHS already has conducted some additional sampling. In many cases, there is a lack of existing wells to sample for delineating the extent of contamination. Before installing new monitoring wells, additional local analysis of contaminant migration should be evaluated using available hydrogeologic data, contaminant data, and application of contaminant transport modeling in order to optimize the location of and minimize the number of monitoring wells. Remote sensing techniques, such as soil gas monitoring, should also be evaluated in delineating the extent of contamination and selecting locations of monitoring wells.

The vertical extent of contamination should be confirmed by the drilling of clusters of new monitoring wells, with each cluster defining the variation in contaminant concentrations with depth. As shown by the results of the SSP, contamination may occur at depths in excess of 1,000 feet. The installation of cluster well sets are very expensive; therefore, consideration should be given to evaluating techniques such as spinner logging and depth sampling in existing wells.

The remedial action of the groundwater contamination in the San Gabriel Basin is expected to be multifaceted. Consideration should be given, therefore, to the following for the various areas of identified contamination: 1) establishing remedial response objectives with regard to public health and the environment; 2) identifying remedial action alternatives which are potentially feasible; 3) screening these remedial actions with regard to environmental protection, environmental effects, technical feasibility, institutional feasibility, and cost; and 4) developing acceptable remedial action alternatives, including collection of additional data, as required to support a Record of Decision and selection of a final alternative.

In initiating remedial action evaluations, highest priority should be given to the following:

- Areas containing high levels of contamination which are contributing to the continued spread of contamination. Such areas include contamination near Azusa and just east of the Santa Fe Flood Control Basin, north of El Monte and northwest of Rosemead, at the confluence of Puente and San Gabriel Valleys, and in the Whittier Narrows.

- Areas where the only water supply available to a producer providing drinking water to the public is contaminated above acceptable federal and state levels, or is threatened by movement of contaminants.

Interim remedial measures may be required during the RI/FS to respond to cases similar to Rurban Homes and Richwood Mutual Water Companies. A workplan for the remaining portion of the RI/FS will be developed over the next several months.

LASG3/006

# 1.0
# INTRODUCTION

This report presents the results of the San Gabriel Supplemental Sampling Program (SSP). The San Gabriel supplemental sampling program has been undertaken as part of the U.S. Environmental Protection Agency's (EPA's) response to groundwater contamination in the San Gabriel Basin, Los Angeles County, California under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 (commonly referred to as Superfund).

Groundwater in the San Gabriel Basin is known to be contaminated with volatile organic compounds such as trichloroethylene (TCE), perchloroethylene (PCE), and carbon tetrachloride (CTC). The concentrations of these and other contaminants have been shown to exceed EPA's proposed Maximum Contaminant Levels (MCL's) and/or California Department of Health Services (CDHS) State Action Levels in approximately 58 of the 195 wells sampled in the basin during the first 8 months of 1985. Groundwater is the primary source of drinking water in the basin; therefore, contamination of this water supply poses a potential threat to public health. The San Gabriel SSP has been undertaken to assemble the data necessary to conduct a Remedial Investigation/Feasibility Study (RI/FS) of groundwater contamination in the San Gabriel Basin. The San Gabriel SSP included the initial tasks of the remedial investigation.

## 1.1 BACKGROUND

Groundwater contamination of the San Gabriel Basin by TCE was first observed in December 1979 in samples taken by Aerojet Electrosystems Company in Azusa, California as part of an ongoing environmental monitoring program. These samples, taken from the Valley County Water District's Morada

Street No. 3 Well, reportedly showed a TCE concentration of 1,800 parts per billion (ppb) (California Regional Water Quality Control Board, CRWQCB, 1980). Upon receiving notification of the problem, the California Department of Health Services began a program of sampling wells in the immediate vicinity and found TCE contamination in three additional wells.

These findings prompted the initiation of an expanded sampling program by CDHS and the Los Angeles County Department of Health Services to include the entire San Gabriel Basin and outlying areas. By April 1980, 37 of 246 tested wells within the basin had been found to have TCE concentrations greater than the State's action level of 5 ppb. These 37 wells either were taken out of service or water from them was blended with water from other sources in order to reduce the TCE concentration to below 5 ppb.

On January 7, 1980, the Los Angeles Section of the California Regional Water Quality Control Board (CRWQCB, 1980) began investigating possible sources of the TCE contamination. No specific sources could be pinpointed from inspections of 233 industrial facilities, but some facilities were recommended for further investigation. The CRWQCB (1980) report summarized the status of TCE contamination at that time in the basin and other areas around Los Angeles, presented the background history of the basin, and described a source investigation program. The recommendations of the CRWQCB were that they continue regulation and surveillance of hazardous waste disposal activities to assure that no further groundwater contamination occurs, that selected wells be monitored for TCE on a periodic basis, and that selected wells in all the groundwater basins under their jurisdiction be monitored for priority pollutants on a periodic basis in order to obtain baseline information about groundwater quality.

By September 1983, four areas of contamination were evaluated for listing on the EPA's National Priorities List. In May 1984, San Gabriel Areas 1 through 4 were included on the final National Priorities List. A Remedial Action Master Plan (the overall planning document for the RI/FS) was prepared to address the contamination problem. EPA signed a cooperative agreement with the CDHS in September 1984 giving the CDHS the lead for implementing the RI/FS activities except the SSP.

By late 1984, the CDHS sampling program had identified 59 wells contaminated by TCE, PCE, and/or CTC. The various water purveyors in the basin have been operating under an interim operating plan imposed by the CDHS and either have taken the contaminated wells out of service, resorted to blending or to intermittent use to maintain average contaminant concentrations below action levels, or are trying various treatment methods.

By taking these measures, all but three water purveyors in the basin have been able to provide a water supply to their users that meets proposed federal MCL's and CDHS State Action Levels. The exceptions are the Richwood, Rurban Homes, and (until recently) Hemlock Mutual Water Companies. These water companies have continued to supply water contaminated with compounds whose concentrations exceed CDHS Action Levels. The primary contaminant in the Richwood, Rurban Homes, and Hemlock wells is PCE.

Initial remedial measures for the Richwood, Rurban Homes, and Hemlock Mutuals were analyzed and addressed in the <u>Focused Feasibility Study, San Gabriel</u> (CH2M HILL, 1983). Relatively low levels of TCE in addition to the PCE have been identified. Water users have been instructed to use bottled water or another water supply or to boil the water from their system before use. Sampling data obtained in May and June of 1983 (Stetson Engineers, 1983) indicate that the PCE level in the Rurban Homes area has dropped to less than 4 ppb; however, the concentration in all preceding samples had been at least 8 ppb. Hemlock Mutual Water Company has installed and they are operating a water treatment system to remove contaminants. Water treatment systems for Richwood and Rurban Homes are being designed by an EPA contractor.

In September 1983, California Assembly Bill 1803 (AB 1803) was passed, becoming law effective January 1, 1984. The provisions of AB 1803 require that public water systems with more than 200 service connections initiate a one-time monitoring program to qualitatively and quantitatively determine the presence of organic chemicals in the groundwater (though further monitoring is required if contamination is found). The organic chemicals for which analyses are to be performed is to be based on the characteristics of the potential sources of contamination. These potential sources include industries, agriculture, waste disposal sites, cemeteries, golf courses, and parks. Assembly Bill 1803 also requires that those public water systems with the greatest potential for groundwater contamination be the first to submit plans to CDHS.

The water analysis program consists of three phases to be completed in a 7-month period. Phase I is the preparation of a water analysis plan by the water systems and is to be completed within 90 days of receipt of notification from CDHS. Phase II is the CDHS review and subsequent approval of the water system's water analysis plan. Implementation of the approved water analysis plan constitutes Phase III of the program. Within 90 days of receiving approval of the plan from CDHS, all samples are to be taken and analyzed and a final report prepared summarizing the results of the water analysis program.

The report on Phase III results has been submitted to the CDHS on May 31, 1985. Of the 119 wells sampled, 35 have been found to contain contaminants at or above the CDHS Action Levels. These results and the results of the sampling performed for this study are presented in this SSP report.

EPA initiated the SSP in October 1984 to analyze existing data and collect new information needed to further define the extent of groundwater contamination in the San Gabriel Areas 1 through 4. The sampling activities were planned in coordination with the AB 1803 sampling program in order to supplement information obtained from that program. Sampling activities as part of the SSP were completed in May 1985.

EPA, through its Field Investigation Team (FIT) and Technical Enforcement Support (TES) contractors, is currently investigating potential contamination sources. From this investigation, suspected polluters have been identified. EPA has mailed them Resource Conservation and Recovery Act (RCRA) Section 3007/CERCLA Section 104 letters. These letters are intended to obtain information about past and present industrial processing, the types of chemicals used and wastes generated, and the treatment and disposal of these wastes.

In March 1985, the CDHS informed the EPA that it did not wish to implement the RI/FS, and the lead role returned to the EPA. In September 1985, the EPA signed a cooperative agreement with the Upper San Gabriel Valley Municipal Water District. The EPA will conduct the RI/FS and the District will provide technical assistance to the EPA. In addition, the District will be responsible for conducting community relations activities relating to the RI/FS. In conducting the RI/FS, the EPA will treat all of the San Gabriel 1 through 4 sites as one site for management purposes.

## 1.2 PURPOSE

The primary purpose of the San Gabriel SSP has been to complete the initial tasks of the remedial investigation, which included obtaining and analyzing the data necessary to develop a detailed plan for the remaining activities of the San Gabriel Basin RI/FS. Numerous groundwater samples have been collected and analyzed since groundwater contamination has been detected in the basin; however, a thorough evaluation of the extent of contamination had not been conducted.

Most of the water samples that have been collected historically have shown contamination by TCE, PCE, and CTC. The consistency of the water quality data has been questioned because samples have been collected and analyzed by a number of different parties. The direction and rate of contaminant migration has not been assessed in previous programs. This lack of information precluded the development of a detailed plan for the RI/FS, which would have a reasonably well-defined scope of work.

The San Gabriel SSP has been coordinated with the groundwater sampling activities conducted in response to the AB 1803 program. Specific objectives of the data compilation, collection, and analysis activities include the following:

- Develop a centralized data base on the geology, hydrology, groundwater contamination, and groundwater utilization in the basin

- Develop an understanding of groundwater conditions in the basin and factors controlling groundwater flow directions and rates

- Determine the nature of contaminants in the groundwater in addition to TCE, PCE, and CTC

- Determine the lateral and vertical extent of contamination

- Determine potential source areas of groundwater contamination

- Evaluate the rate and direction of contaminant migration

- Conduct an initial assessment of the no-action alternative

- Conduct an initial evaluation of the feasibility of replacing contaminated groundwater with surface water supplies

- Provide recommendations for further work to be conducted during the RI/FS

## 1.3 SCOPE

The scope of the San Gabriel SSP has involved field, laboratory, and analytical activities to achieve the objectives of the SSP. These specific activities have included the following:

- Collection and compilation of available reports and data on geologic and hydrologic conditions, groundwater utilization, and groundwater contamination

- Review of the water analysis program for the Main San Gabriel Basin, prepared in response to AB 1803

- Development of a sampling plan to collect groundwater samples in coordination with the AB 1803 sampling program

- Collection of groundwater samples from 70 wells for the analysis of volatile and semi-volatile organic compounds, selected agricultural chemical compounds, and selected contaminants believed to be related to potential sources of contamination

- Laboratory analysis of the collected groundwater samples through the EPA Contract Laboratory Program (CLP)

- Construction of a numerical three-dimensional groundwater flow model of the San Gabriel Basin

- Application of the model results to identify potential source areas of contaminants and assess the continued spreading of contaminants

- Evaluation of available groundwater contamination data and data collected as part of the AB 1803 program, and SSP and CDHS activities to delineate the lateral and vertical extent of contaminants

- Preliminary assessment of the no-action alternative based on the distribution and levels of contaminants related to existing federal standards and state guidelines

- Assessment of the feasibility of replacing contaminated groundwater with surface water based on the quantity of groundwater exceeding contaminant action levels, and potential availability and cost of replacement water

- Identification of data gaps to be addressed in the RI/FS

## 1.4 ORGANIZATION OF REPORT

This San Gabriel Supplemental Sampling Program report is organized as follows:



The main text presents the findings and results of the San Gabriel Supplemental Sampling Program with regard to the objectives identified in Section 1.2. Appendix A presents the details of the hydrogeologic evaluation including the methodologies and assumptions employed in evaluating groundwater flow conditions and in the assessment of potential contaminant source areas and contaminant migration. Appendix B presents the details of the groundwater sample collection, documentation, and laboratory analysis results. Appendix B also presents data on groundwater contaminants for the period 1979 through August 1985, although data after May 1985 are sparse because the SSP data collection activities were largely concluded in May.

LASG2/022

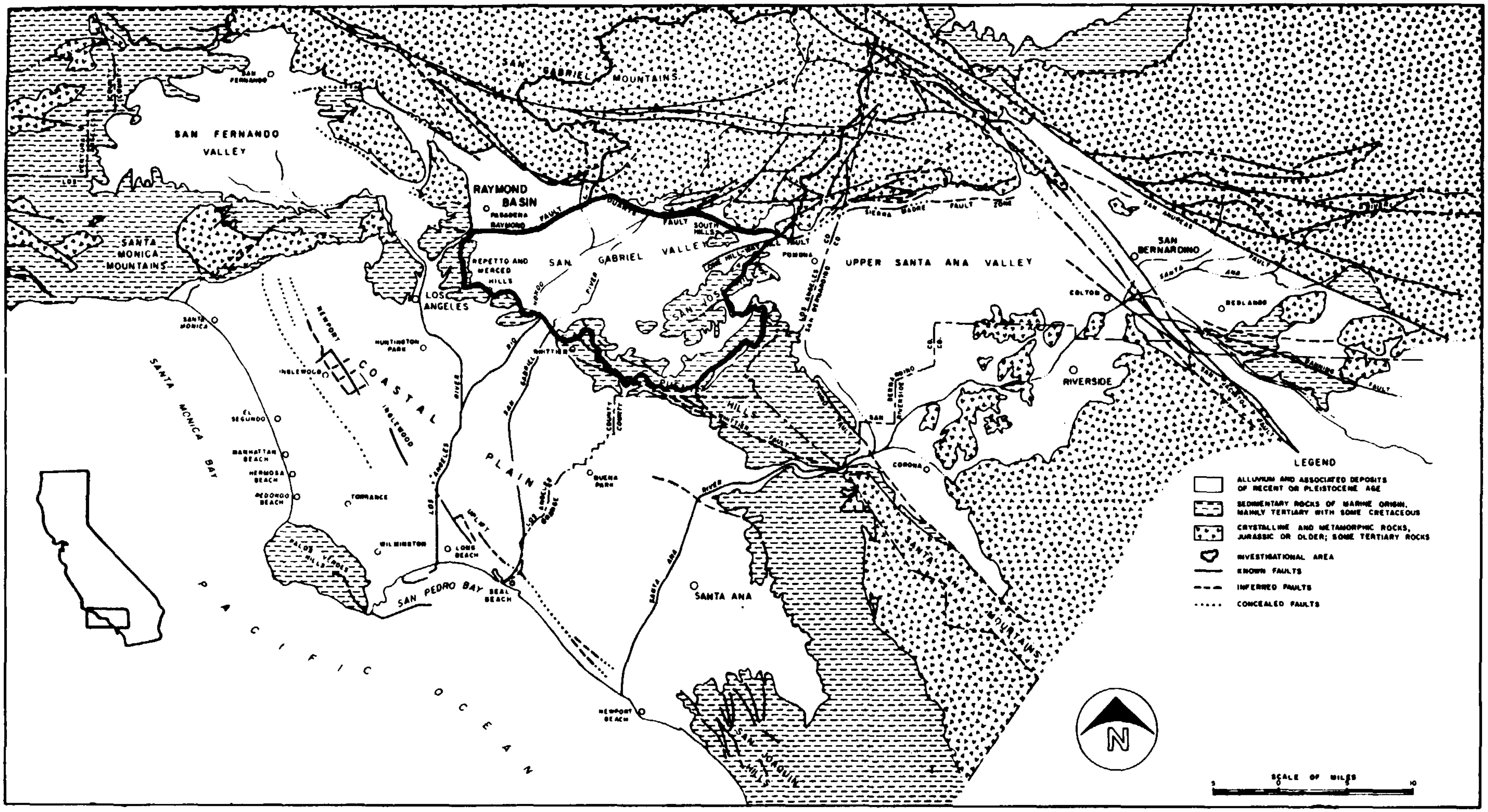
# 2.0
# SITE DESCRIPTION

This section provides a brief description of the physiography, climate, land use and demography, and hydrogeology of the San Gabriel Basin. These descriptions are based on previously published information; and, primarily, reports prepared by the California Department of Water Resources (CDWR) and the Los Angeles County Department of Public Works (more specifically, the former Los Angeles County Flood Control District, LACFCD). This overview summarizes similar discussions, which are presented in more detail in Appendix A.

## 2.1 PHYSIOGRAPHY AND TOPOGRAPHIC SETTING

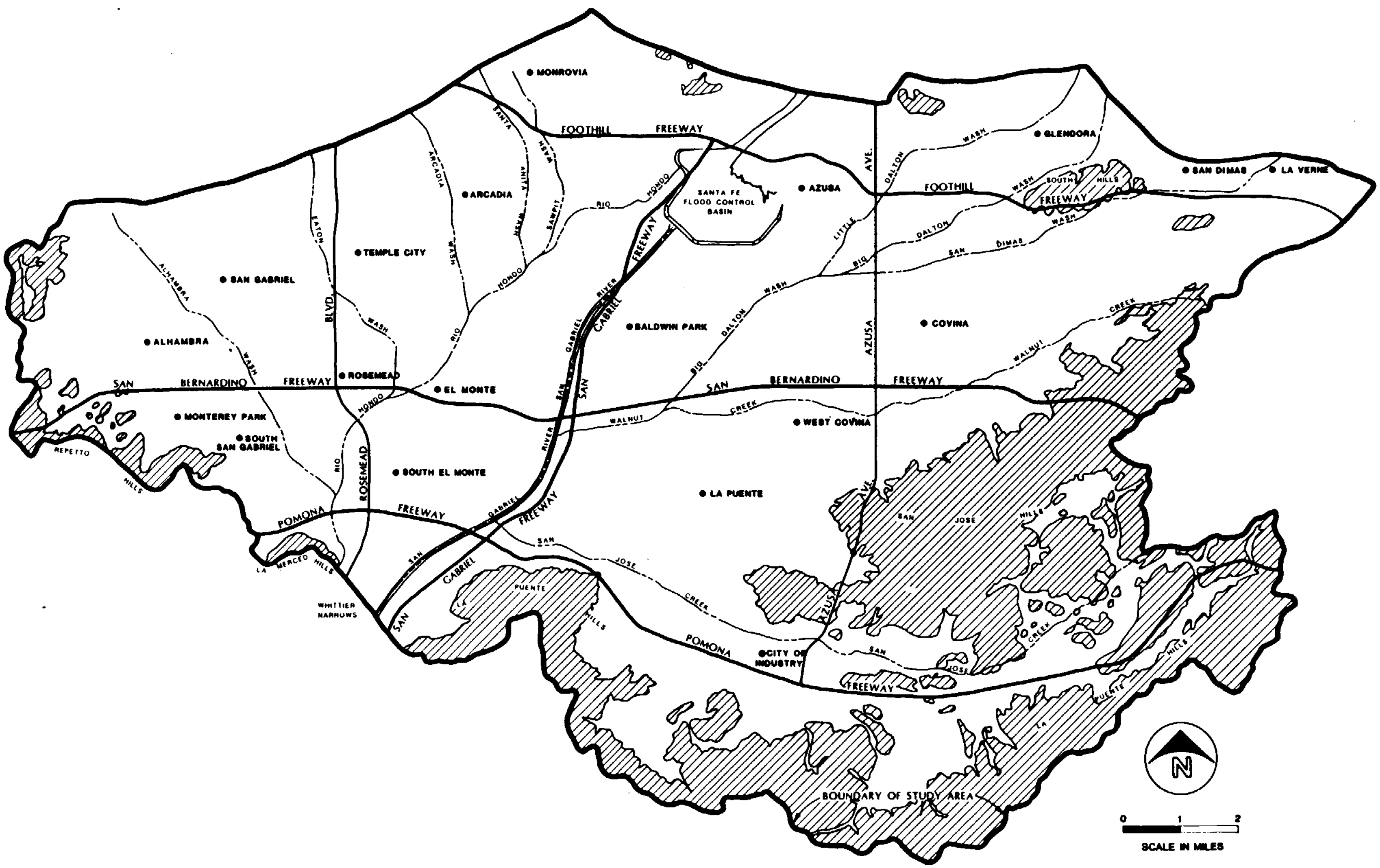
The San Gabriel Basin is located in the eastern portion of Los Angeles County (Figure 2-1). The San Gabriel Basin, as it is called throughout this report, is the "San Gabriel Valley Groundwater Basin" as defined by the CDWR (1966). The CDWR defines the boundaries of the basin as follows: Whittier Narrows to the southeast; the Raymond fault on the northwest; the line of contact between the alluvium and the bedrock of the San Gabriel Mountains on the north; the bedrock high between San Dimas and La Verne on the east; and the Repetto, Merced, Puente, and San Jose Hills on the west and south. These features and the general area of study are shown in more detail in Figure 2-2.

The San Gabriel Mountains lie north of the San Gabriel Basin. These mountains range in elevation from 900 feet at the base to over 10,000 feet above sea level. The mountains are composed primarily of igneous and metamorphic rocks. They are characterized by steep, rocky ridges which are broken by numerous irregular canyons.




SOURCE: CDWR, 1966

**FIGURE 2-1**
**LOCATION AND GENERAL GEOLOGY OF AREA OF INVESTIGATION**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**




LEGEND

NONWATER-BEARING ROCK

**FIGURE 2-2**
**STUDY AREA**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**

The San Gabriel Valley is a broad piedmont plain which slopes from the San Gabriel Mountains toward Whittier Narrows. The average slope of the valley floor in the basin is about 65 feet per mile (CDWR, 1966).

The San Gabriel Basin receives runoff from the surrounding basins, the San Gabriel Mountains, and the periphery hills. The major outflow is through Whittier Narrows by either the Rio Hondo or San Gabriel River which drain most of the valley. The secondary drainages which converge on the Rio Hondo and San Gabriel include, from east to west: Walnut Creek, San Dimas Wash, Big Dalton Wash, Little Dalton Wash, San Jose Creek, Sawpit Wash, Big Santa Anita Wash, Little Santa Anita Wash, Arcadia Wash, Eaton Wash, and Alhambra Wash. These drainages are all characterized as intermittent streams, typically dry during the summer months. However, Rio Hondo and the San Gabriel River may flow near Whittier Narrows. These drainages are shown in Figure 2-2. The drainages of the basin have been improved with concrete-lined bottoms and sides, except for the San Gabriel River and a portion of Rio Hondo near Whittier Narrows. Most of the channel bottom of the San Gabriel River has been left pervious in order to allow water to percolate and replenish the groundwater supply.

## 2.2 CLIMATE

The climate of the San Gabriel Basin is considered subtropical to semiarid. About 77 percent of the annual precipitation occurs during December through March. This precipitation varied from 27 inches on the frontal area of the San Gabriel Mountains to an average of 18 inches over the valley floor, during the period 1933 through 1960.

Temperatures in the valley are usually moderate. The average annual temperature in the basin is about 62 degrees Farenheit

(CDWR, 1966). Temperatures rarely drop below freezing. The summer months may occasionally bring temperatures above 100 degrees Farenheit.

## 2.3 LAND USE AND DEMOGRAPHY

Urbanization of the San Gabriel Valley began in the early 1900's. However, agriculture was the major land use until the 1950's. Between 1940 and 1960, the population of the valley tripled; between 1960 and 1980, it increased by about one-third. The 1980 census indicates that the population of the San Gabriel Valley is nearing one million people (Stetson Engineers, 1985).

Presently, agricultural lands tend to be located along portions of the perimeter of the San Gabriel Valley, along rights of way adjacent to the San Gabriel River and in portions of the Puente Valley. Agricultural plots are discontinuous and relatively small. Major industrial areas are located mainly along the banks of the San Gabriel River, and within portions of the City of Azusa in the northeast portion of the basin and the City of Industry in the southeast. Land use in the valley is now primarily residential and commercial.

## 2.4 HYDROGEOLOGY

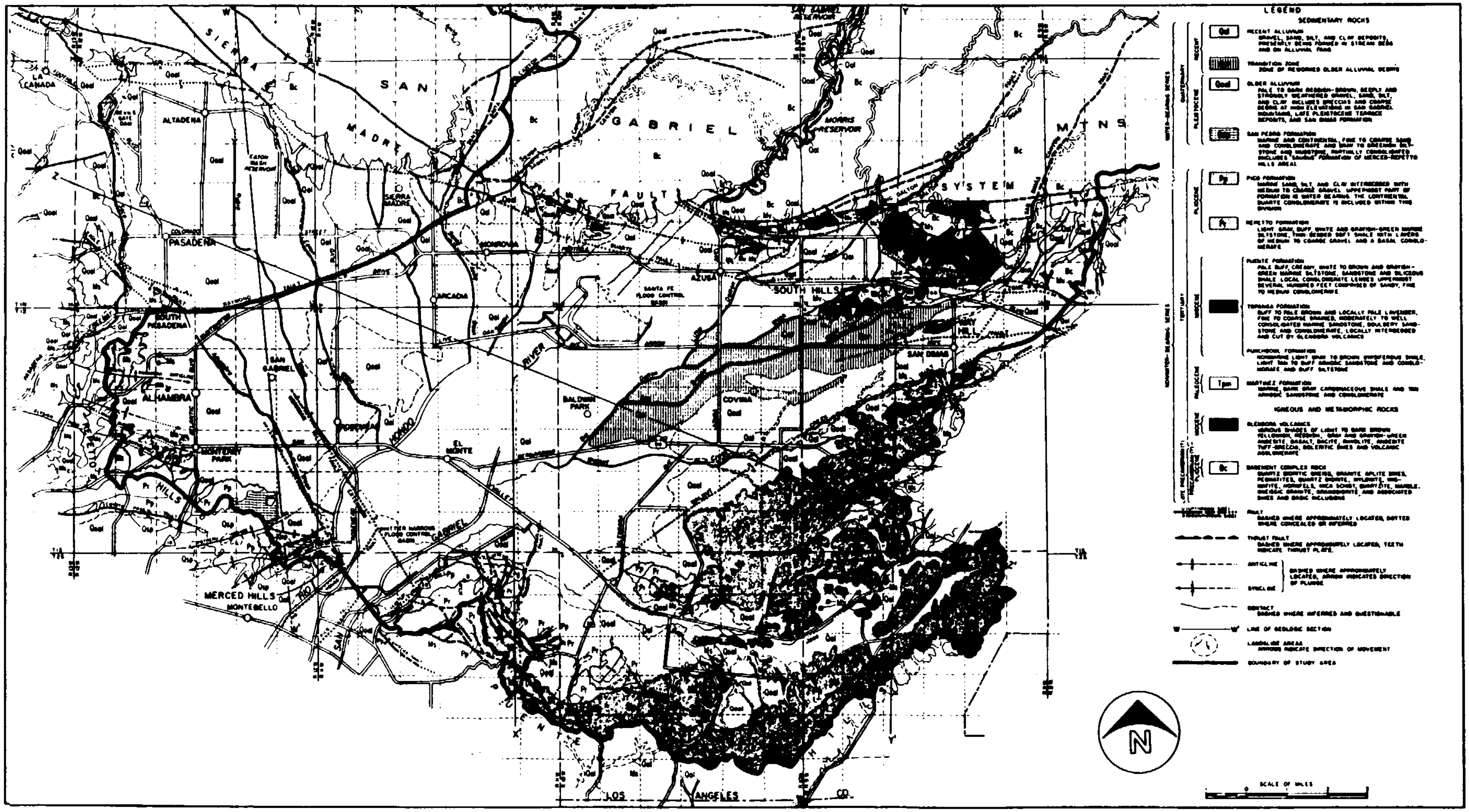
The San Gabriel Basin is a bowl-shaped depression formed by downward movement along fault zones near the perimeter of the basin. Coincidental uplifting on opposite sides of the down-dropped valley floor formed the surrounding hill and mountainous areas. Erosion of the uplands resulted in the gradual filling of the basin with alluvial sediments.

### 2.4.1 HYDROGEOLOGIC UNITS

Figure 2-3 is the regional geologic map presented by the CDWR (1966). As shown on this map, the CDWR (1966) identifies nonwater-bearing formations, which are defined as rock units which yield relatively limited quantities of water to wells (5 to 100 gallons per minute), and include: (1) the igneous and metamorphic rock complexes forming the San Gabriel Mountains and (2) the consolidated sedimentary rocks which form the low lying hills along the periphery of the basin. Igneous and metamorphic rocks also occur to a limited extent in the San Jose, South, and Puente Hills. Detailed descriptions of these nonwater-bearing formations are given in CDWR (1962 and 1966).

The term nonwater-bearing formations is used in the report because much of the hydrogeologic information has been taken from the CDWR's (1966) report. However, those areas underlain by nonwater-bearing formations may be important considerations in later phases of investigation because of the occurrence of potential sources of contamination located in these areas. Potentially, even small contributions of groundwater from these areas may be significant if the groundwater is contaminated.

The water-bearing formations, which provide significantly higher yields to wells (100 to 4,600 gpm), are principally unconsolidated and partially consolidated nonmarine sediments of Recent and Pleistocene age. Marine sediments of probably Pleistocene age and marine sediments of late Pliocene age are included with the water-bearing formations. The sediments generally consist of coarse sediments with gravel and boulders close to the mountain fronts and major rivers. Finer grained sediments make up larger percentages of the sediments with increasing distance from the mountains and rivers. This variation in the nature of the sediments




SOURCE: CDWR, 1966

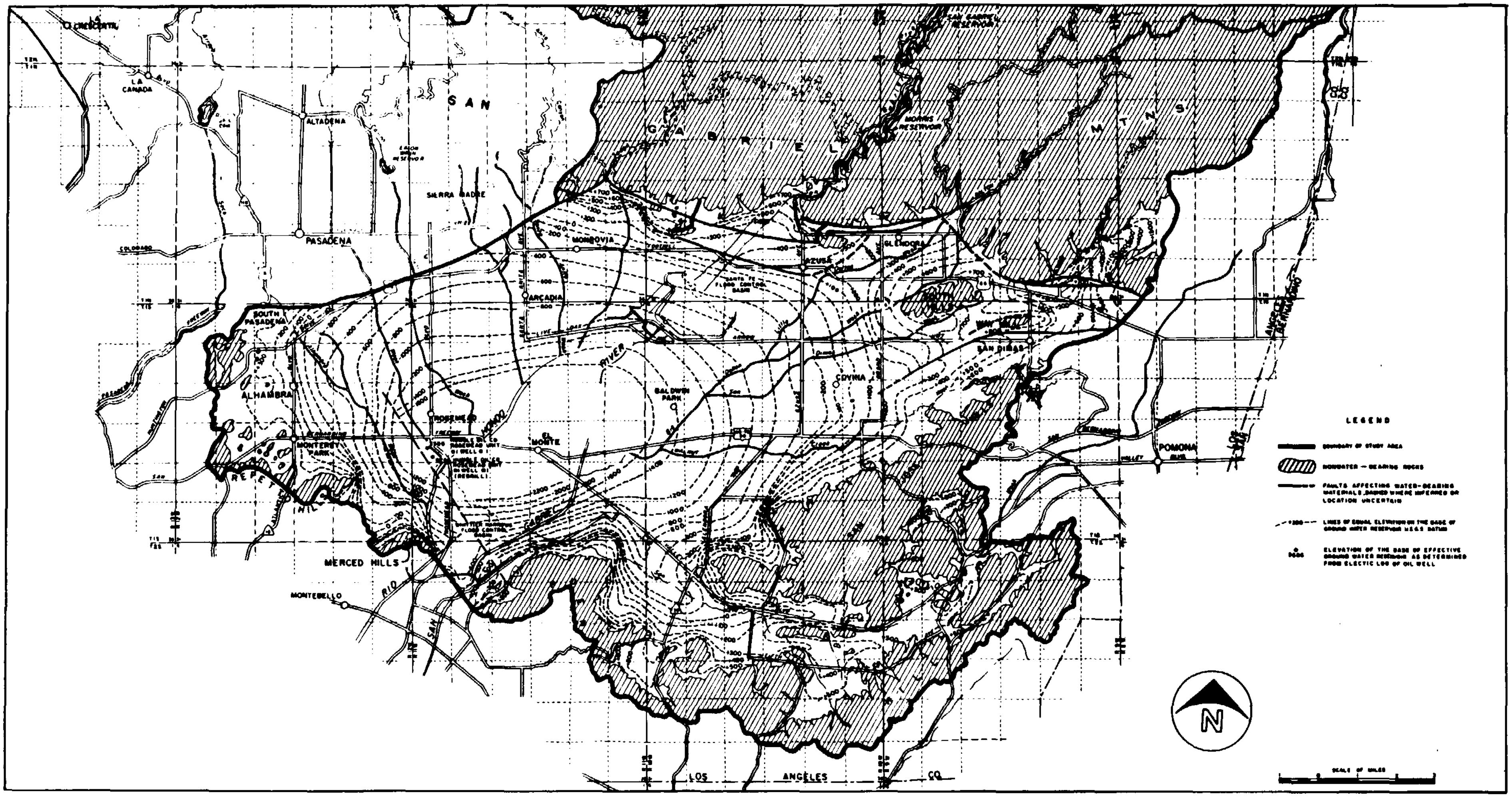
**FIGURE 2-3**
**REGIONAL GEOLOGY**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**

causes a similar variation in hydraulic conductivity. Values ranging from 100 to 300 ft/day occur near the rivers and mountains; moving away from these features, hydraulic conductivity decreases to about 10 to 50 ft/day. Although each formation making up the water-bearing series has been described in some detail (CDWR, 1966), the most important geologic condition of significance to the evaluation of their hydrogeologic properties is the trend in sediment size variations. Otherwise, the formations of the water-bearing series do not have individually distinctive hydrogeologic properties which require differentiation for hydrogeologic analyses.

The water-bearing series of formations range up to a maximum depth of over 4,000 feet. Figure 2-4 is a map reproduced from the CDWR (1966) which shows the elevation of the effective base of the groundwater reservoir. As shown by this map, the alluvial basin is deepest in an area just southwest of the center of the basin, based on oil wells drilled in the area. This map also demonstrates the effect of major faults on the thickness of the alluvium.

### 2.4.2 OCCURRENCE AND MOVEMENT OF GROUNDWATER

Groundwater occurs principally in the water-bearing formations described in Section 2.4.1. Groundwater is stored and easily transmitted through the intergranular pore space of the unconsolidated and partially consolidated alluvial sediments. Groundwater also occurs in the nonwater-bearing formations. The permeability and storage characteristics of the nonwater-bearing formations, contrasted to the water-bearing formations, is expected to be such that the nonwater-bearing formations can be neglected in the analyses of groundwater movement in the basin, except as noted previously with regard to sources of contamination. This assumption is evaluated further in Appendix A.




SOURCE: CDWR, 1966

**FIGURE 2-4**
**THE EFFECTIVE BASE OF THE ALLUVIAL AQUIFER**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**

Groundwater movement in the San Gabriel Basin is generally from the perimeter of the basin toward Whittier Narrows, which is the only subsurface outflow (through alluvium) in the basin. Faults on the perimeter of San Gabriel Basin have a major impact on groundwater flow within the basin. The significant faults in the San Gabriel Basin (Figure 2-3) affecting the water-bearing formations are as follows (CDWR, 1966):

- The Sierra Madre fault system which trends generally east to west at the base of the San Gabriel Mountains; in particular, the Duarte, Cucamonga and an unnamed fault. Groundwater occurring in the water-bearing series, north of these faults, effectively "cascades" across the faults into the basin.

- The northwestern boundary of the basin is placed along the Raymond fault. Groundwater movement across this fault to the southeast is apparently affected as shown by marked differences in groundwater levels across the fault.

- The Lone Hill-Way Hill faults displace the water-bearing formations, but they have only a limited effect on groundwater movement.

- The Workman Hill fault extension occurs in the southwestern portion of the basin and crosses Whittier Narrows. The water-bearing formations are offset by this fault, but it does not appear to affect groundwater movement.

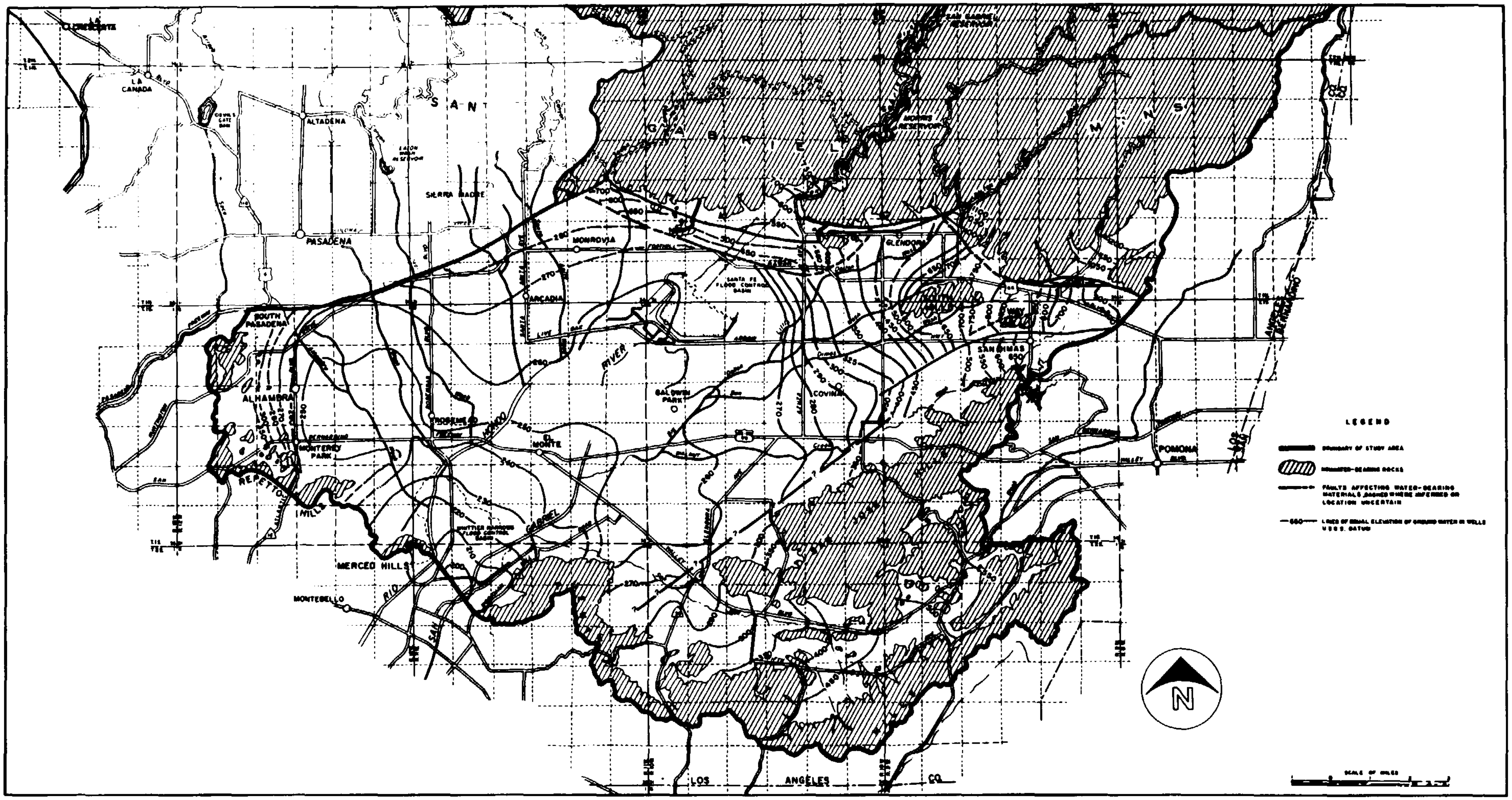
- The Walnut Creek fault trends northeast-southwest in the southeastern part of the basin. Although the water-bearing series is affected by this fault, it apparently has a very limited effect on groundwater levels.

Groundwater use in the San Gabriel Basin is extensive, and it represents more than 90 percent of the available water supply. There is a heavy reliance on the alluvial aquifer for municipal water supply and groundwater flow patterns have changed as a result of continued aquifer development. Figure 2-5 shows the groundwater levels in Fall 1933. Figure 2-6 shows the groundwater levels in the Fall of 1982 and the location of about 250 active wells for which the Main San Gabriel Basin Watermaster has recorded pumping rates. Figure 2-6 shows that the continued pumping of the aquifer has caused the water table elevations to decline near major pumping centers, (i.e., near West Covina and San Gabriel). In the vicinity of these cones of depression, groundwater flow directions have changed and in some areas are reversed from the conditions observed in 1933.

### 2.4.3 GROUNDWATER RECHARGE AND USE

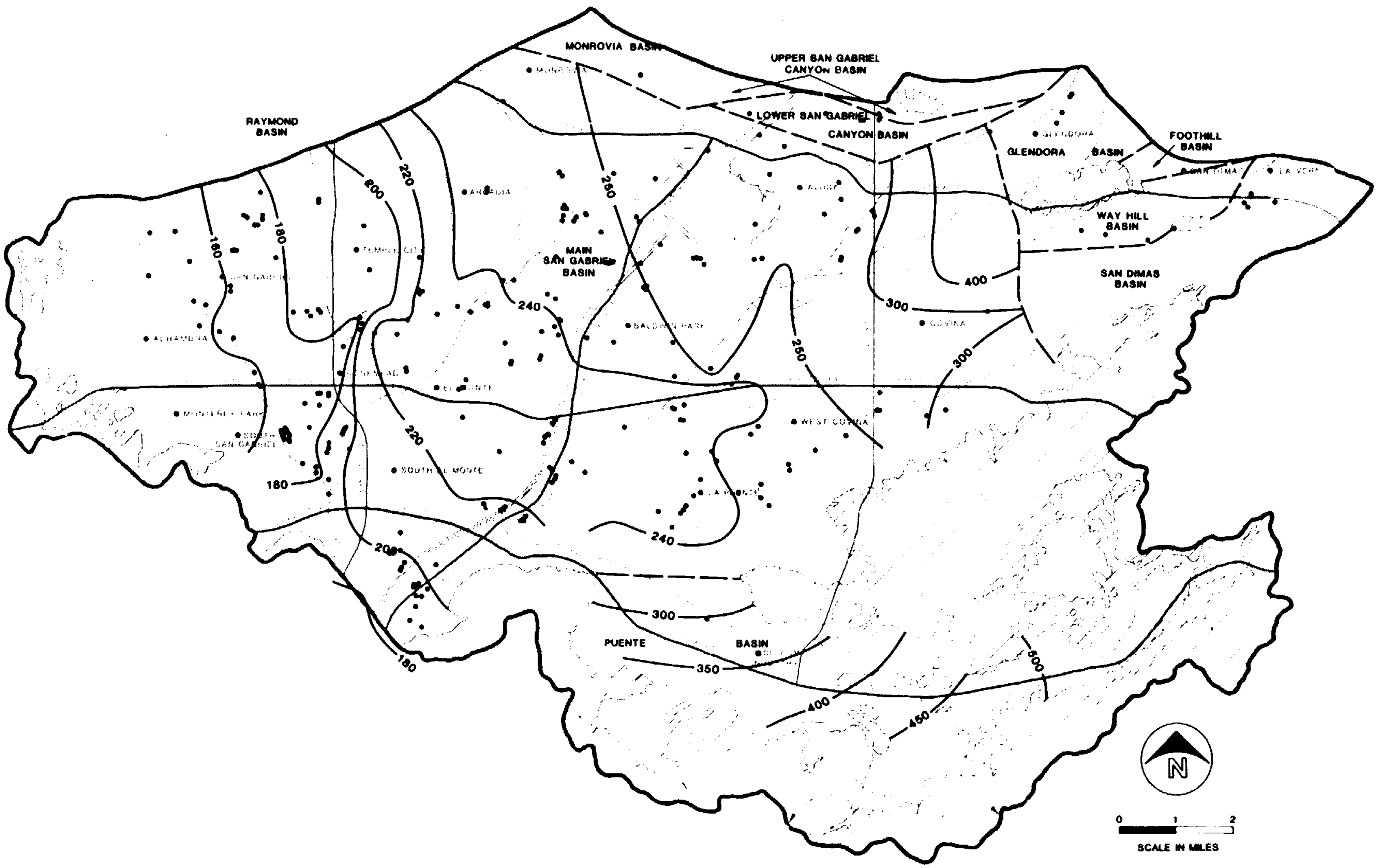
Sources of groundwater in the basin include the following:

- o Deep percolation of precipitation
- o Deep percolation of delivered water, (i.e, waste water and irrigation water)
- o Percolation of surface water through streambeds
- o Artificial recharge at spreading basins
- o Subsurface inflow from adjacent basins




SOURCE: CDWR, 1966

FIGURE 2-5
GROUNDWATER LEVELS
IN FALL 1933
SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM




**LEGEND**

—160— WATER LEVELS, FALL 1982

• LOCATION OF PUMPING WELL

— — — BASIN BOUNDARY

NONWATER-BEARING ROCK

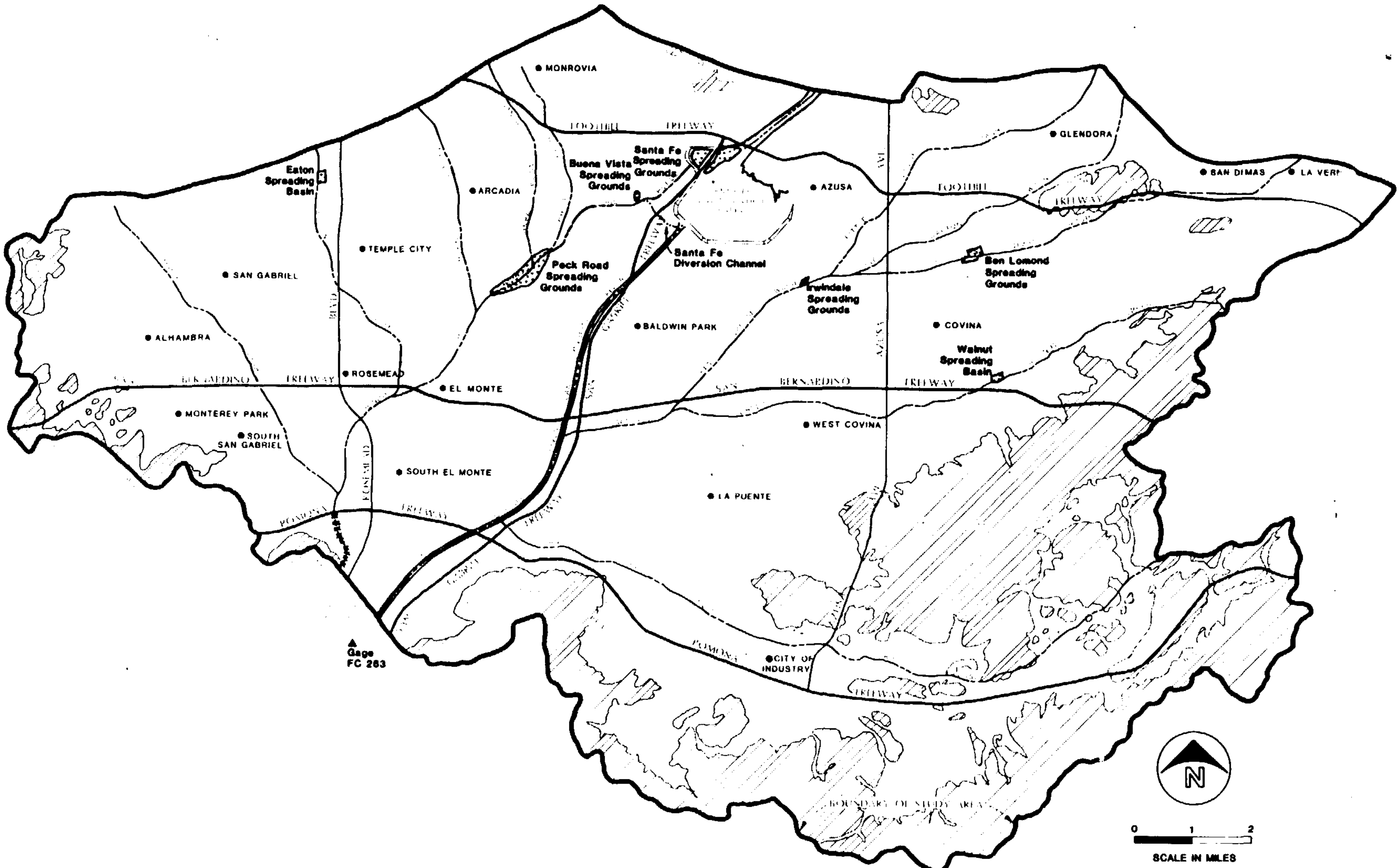
SOURCE: LACFCD, 1982

**FIGURE 2-6**
**GROUNDWATER BASINS IN THE SAN GABRIEL VALLEY**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**

Deep percolation of precipitation is defined, for this discussion, to be that component of precipitation that infiltrates to the groundwater table. That is, the precipitation, less surface runoff, and less evapotranspiration losses. This component has been estimated based on an empirical relationship developed by the CDWR (1966). Percolation of surface water through streambeds and artificial recharge at spreading basins include water imported into the basin, as well as that derived from local runoff. Estimates of these components were obtained from the LACFCD (1977-84). The locations of the spreading basins and the unlined channels through which percolation occurs are shown in Figure 2-7.

Potentially, the percolation of delivered water (water provided to a customer for domestic, agricultural, commercial, or industrial uses) may also contribute to recharging the basin. The magnitude of this component is difficult to estimate; however, it is assumed to be small compared with the other components. This water is probably consumed largely by evapotranspiration or directly runs off to surface drainages. As discussed in Appendix A, this component is estimated to range from 0 to 10 percent of the water produced from pumping.

The selection of a study area defined by natural hydrogeologic boundaries facilitates the analysis. Therefore, the groundwater budget and numerical model analyses focus on the Main San Gabriel Basin as defined by the LACFCD (1982). This area is bounded by the Raymond Fault (Raymond Basin) on the northwest; by the Duarte fault system on the north, by the Glendora, Way Hill, and San Dimas Basins to the northeast, the San Jose Hills to the southeast; the Puente Basin and Whittier Narrows to the south; and the Repetto and Merced Hills to the southwest. This is an area of approximately 112 square miles, or 71,680 acres.




**LEGEND**

SPREADING BASIN

UNLINED CHANNEL

REACH OF GROUNDWATER DISCHARGE TO RIVERS

LINED CHANNEL

NONWATER-BEARING ROCK

**FIGURE 2-7**
**SURFACE WATER FEATURES WITHIN THE MODEL AREA**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**

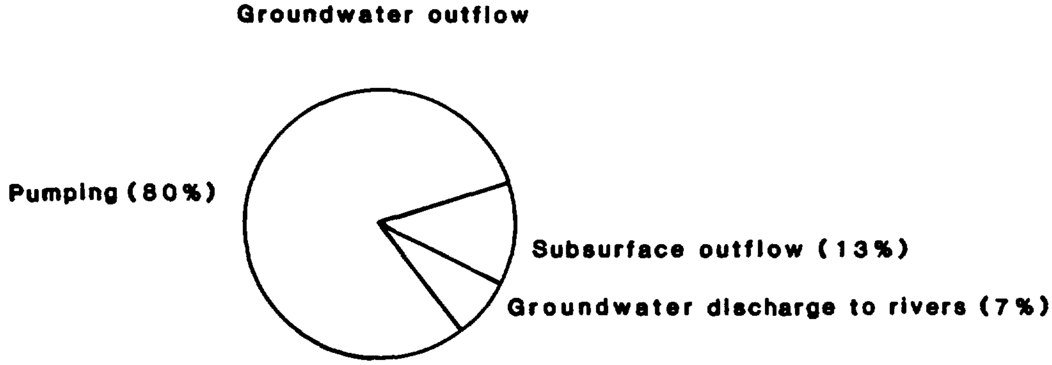
Subsurface inflow into the Main San Gabriel Basin occurs from the adjacent Raymond, Monrovia, Upper and Lower San Gabriel Canyon, Glendora, Way Hill, San Dimas, and Puente Basins, as shown in Figure 2-6. The amount of water entering the Main San Gabriel Basin from these areas has been estimated using Darcy's law and water table maps (LACFCD, 1977-1982). During the period from October 1977 through June 1984, an average of 269,600 acre-feet per year (ac-ft/yr) entered the Main San Gabriel Basin from these sources. Figure 2-8 shows the relative magnitudes of the components of this total inflow. On the average, groundwater inflow to the basin is about evenly divided among riverbed leakage, recharge from precipitation, artificial recharge at spreading grounds, and subsurface inflow. These analyses are described in more detail in Appendix A.

Groundwater leaves the basin by:

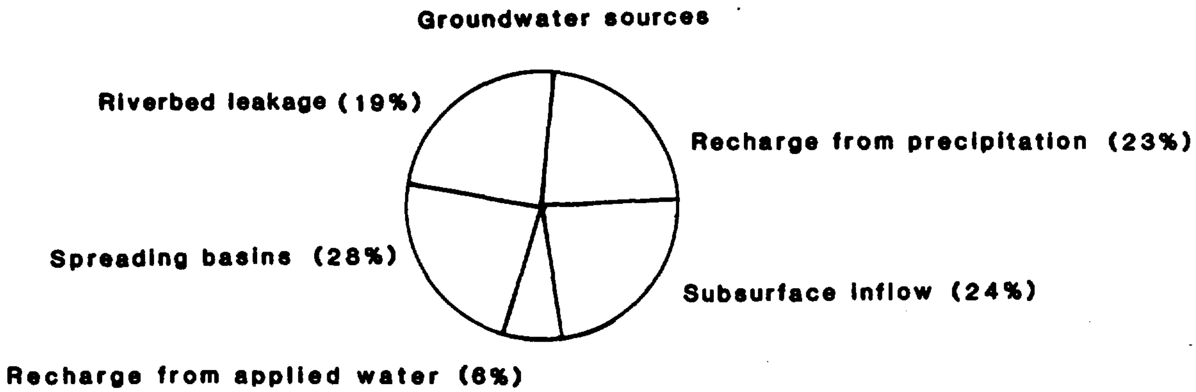
- Subsurface outflow
- Groundwater pumping
- Groundwater discharge to rivers

Subsurface outflow is known to occur only at Whittier Narrows. Also at Whittier Narrows, groundwater discharges to the San Gabriel River and Rio Hondo. The withdrawal of groundwater by wells, for municipal, domestic, and industrial purposes, accounts for over 80 percent of the groundwater extracted from the basin as indicated in Figure 2-8. The remainder of the outflow is divided between subsurface outflow and groundwater discharge to rivers.

Water levels in the basin fluctuate considerably, in response to primarily changes in pumping rates and patterns and changes




Total annual groundwater outflow averaged
216,000 ac-ft/yr from October 1977 to June 1984




Total annual groundwater inflow averaged
270,000 ac-ft/yr from October 1977 to June 1984

FIGURE 2-8
RELATIVE MAGNITUDE OF COMPONENTS
OF THE GROUNDWATER BUDGET
SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM

in recharge from precipitation. Nonetheless, the basin can be considered to be in a rough state of dynamic equilibrium with the sources of groundwater in the basin being approximately balanced by the withdrawals and outflow from the basin.

LASG2/023

# 3.0
# SUPPLEMENTAL SAMPLING PROGRAM

This section of the report presents the results of two principal activities undertaken as a part of the San Gabriel SSP. The first part of this section presents the results of groundwater sampling activities in the basin. These data and historical data compiled on groundwater contamination are discussed with regard to the observed types and extent of contamination in the basin. Details of sampling activities and compilation of historical data are presented in Appendix B. Appendix B also presents a computer printout of available historical groundwater contaminant data.

The second part of this section describes a three-dimensional groundwater flow model which has been developed to simulate regional groundwater flow in the San Gabriel Basin. Included in this discussion is the application of the modeling results to assess possible historical movements of contaminants from potential source areas and potential migration of contaminants based on groundwater movement. Detailed descriptions of the modeling activities, assumptions, and methodologies are provided in Appendix A.

## 3.1 GROUNDWATER SAMPLING

The groundwater sampling program designed for the San Gabriel SSP comprises three parts: quality assurance sampling, source sampling, and general sampling. Concurrent with the SSP, a groundwater sampling program has been conducted in response to AB 1803. The Upper San Gabriel Valley Municipal Water District (USGVMWD) and the San Gabriel Valley Municipal Water District (SGVMWD) sponsored the AB 1803 sampling program. Available water quality data, including historical data and data collected in the first 8 months of 1985, have been entered into a computerized data base management system, referred to as TDM II (CH2M HILL, 1985b), for ease of storage, retrieval, analysis, and display (see Appendix B).

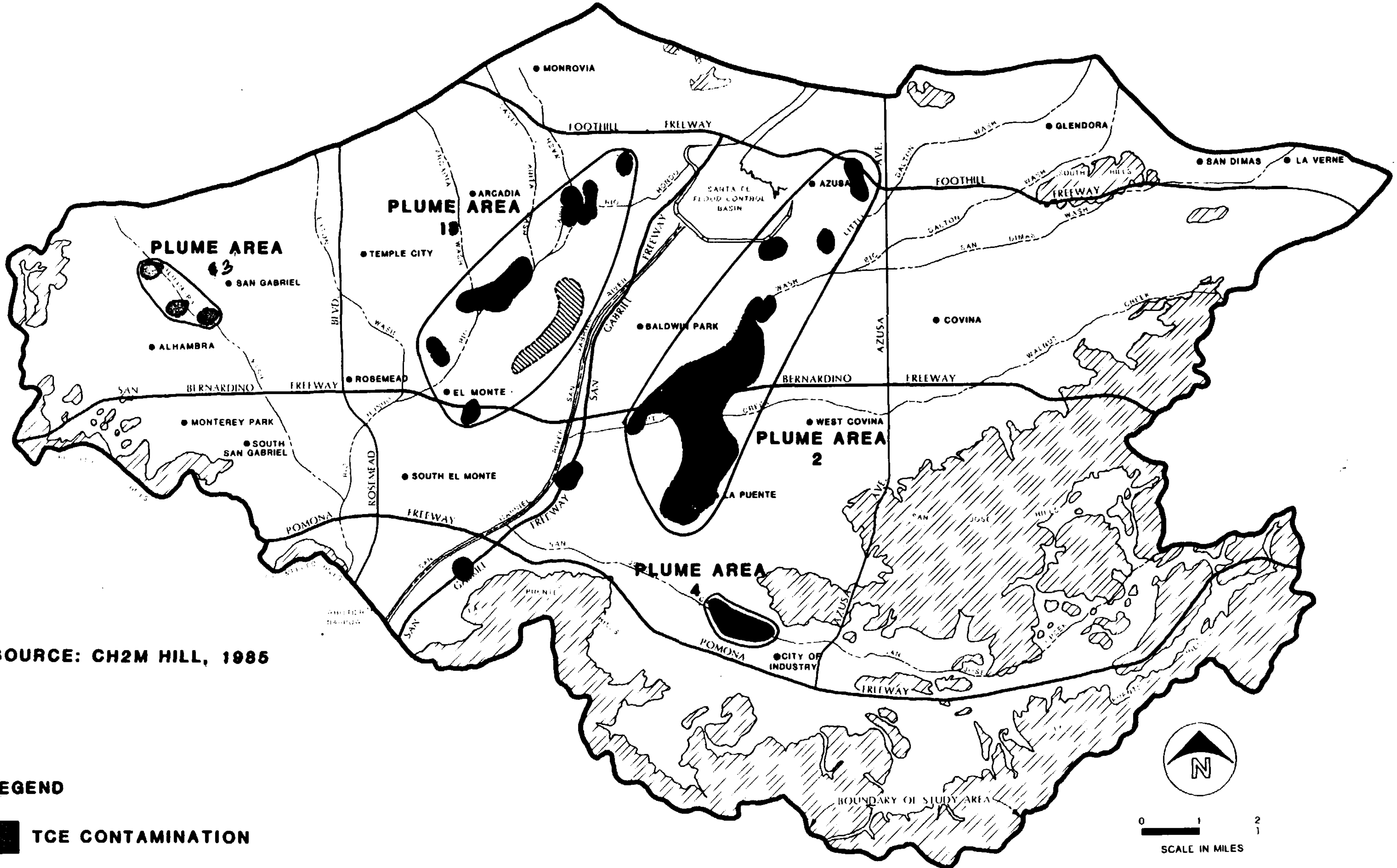
In accordance with the requirements of AB 1803, a total of 119 wells were sampled which represents more than 25 percent of the wells operated by the 33 major water purveyors in the San Gabriel Basin. In general, the criteria for selection of wells to be sampled were: (1) the location of the well within a contaminant plume or plumes, (2) if no plume, wells downgradient of the potential source of pollution, (3) a well's ability to be pumped, (4) the depth of the highest perforation interval, (5) the depth of well casing, (6) the well is known to be contaminated with an organic chemical, and (7) geologic strata which the well penetrates.

Historically, there were extensive agricultural activities in the valley. Crops currently grown in the valley (to a limited extent) are avocados, flowers, grains, grapefruit, hay, lemons, nursery stock, oranges, strawberries, stone fruits, and vegetables. The predominant crop is nursery stock. Organic pesticides and herbicides have been and are being used on these crops. In areas where potential groundwater contamination with organic pesticides and herbicides are suspected, analysis for these compounds has been included in the AB 1803 sampling plan.

The AB 1803 sampling program is a comprehensive program which provides coverage of areas throughout the San Gabriel Basin. For the objectives of the SSP, however, the sampling of additional wells has been necessary. A quality assurance (QA) sampling program has been performed to compare the sampling results obtained from the AB 1803 program with the results obtained from the SSP program. A total of 17 wells were sampled for quality assurance purposes at the same time samples were collected for the AB 1803 program. A total of 14 wells have been sampled in the vicinity of potential source areas of contamination near Azusa, California. The water samples from these wells have been analyzed for volatile and semi-volatile organic compounds, agricultural chemical compounds, and specific chemical compounds that have been reportedly used or disposed of in the area. Eight of the wells sampled for QA purposes have also been sampled for the source sampling activity. A combined total of 23 different wells has been sampled for these two sampling activities.

Four major areas of groundwater contamination have been identified previously (CH2M HILL, 1985a) in the San Gabriel Basin as shown in Figure 3-1. A total of 47 wells have been sampled to complement the sampling conducted for the AB 1803 program, quality assurance sampling, and source sampling activities. This sampling has been undertaken to better define the extent of the San Gabriel Areas 1 through 4 sites listed on the EPA's National Priorities List. In these areas of previously known or suspected contamination, which were based on data available through 1983, as shown in Figure 3-1, the following criteria have been used in selecting wells to be sampled in the general sampling program.

| Well Location Relative to Known or Suspected Areas of Contamination | Reason for Selection |
|---|---|
| o Within known areas of groundwater pollution | Provides updated measure of level of contamination. Most wells with TCE and PCE have been analyzed for volatile organics only. The SSP provides for full priority pollutant analysis. |
| o Downgradient of known plume areas | Provides baseline information on areas downgradient of known contamination. |
| o Adjacent to known plume areas | Provides data on the lateral extent of groundwater pollution. |
| o Upgradient of known plume areas | Helps define the pollution source location and/or the water quality upgradient of the contaminated plume. |




SOURCE: CH2M HILL, 1985

**LEGEND**

- TCE CONTAMINATION
- PCE CONTAMINATION
- TCE AND PCE CONTAMINATION
- NON-WATERBEARING ROCK

**FIGURE 3-1**
**EXTENT OF GROUNDWATER CONTAMINATION PRIOR TO 1984**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**

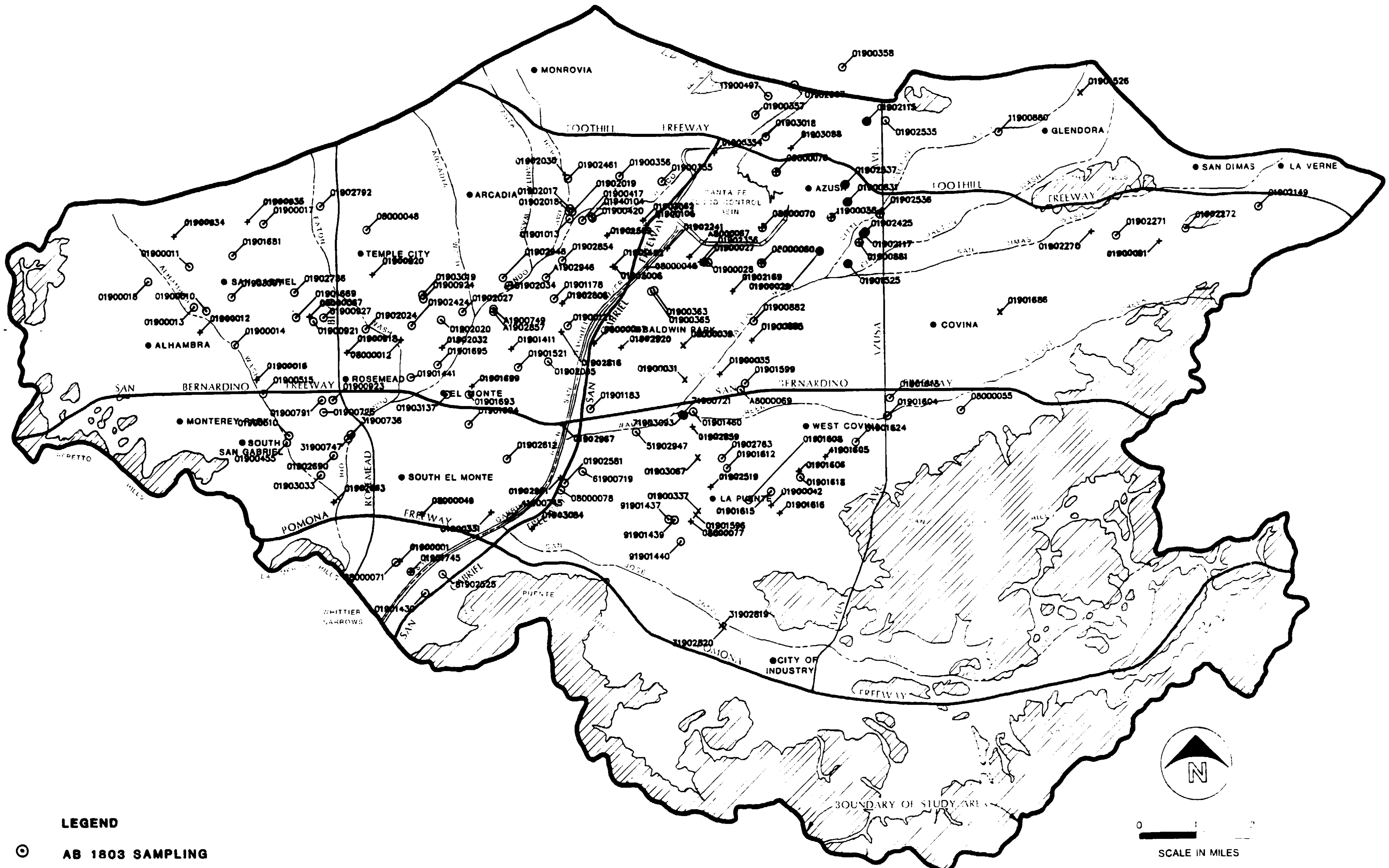
Few wells are available for sampling in major portions of the eastern part of the San Gabriel Basin. Most wells in the eastern part of the basin have been abandoned or destroyed due to existing nitrate contamination. As a result, very few data are available for examining other types of contamination in the eastern part of the basin. The wells sampled during 1985 for the AB 1803 and SSP programs described above are shown in Figure 3-2.

Groundwater contamination data obtained from the above described sampling programs, data collected by the CDHS, and historical data dating back to 1979 have been entered into a computerized data base system (Appendix B). The data base has been used to analyze the types of contaminants in the basin and the extent of contamination. The results of the SSP sampling and evaluation of historical data are presented in the following subsections.

In the following discussion, many references are made to specific wells in the San Gabriel Basin. The references are made with respect to a TDM II well designation number. This number is a modification of the well's state recordation number in most cases. For example, if a well's recordation number is 1900661, the TDM II well designation is an eight-digit number as follows: 01900661. Other designations given to wells in the basin are discussed and cross-referenced in Appendix B.

### 3.1.1 QUALITY ASSURANCE SAMPLING

The locations of the 17 wells sampled by both the AB 1803 program and the SSP for quality assurance purposes are shown in Figure 3-2. Samples were obtained from those wells in accordance with the sampling procedures described by Stetson Engineers, Inc. (1985) for the AB 1803 program and CH2M HILL




**LEGEND**

- ⊙ AB 1803 SAMPLING
- × AB 1803 AND SSP-QA SAMPLING
- ⊕ SSP - SOURCE SAMPLING
- ● COMBINED SSP - QA AND SOURCE SAMPLING
- \+ SSP - GENERAL SAMPLING
- NONWATER-BEARING ROCK

**FIGURE 3-2**
**LOCATION OF WELLS SAMPLED FOR THE SSP AND AB 1803 PROGRAM**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**

(1985a) for the SSP. The AB 1803 program water samples were shipped to Montgomery Laboratories in Pasadena, California. A total of 141 chemical compounds were analyzed for under the AB 1803 sampling program. A complete list of these compounds is provided in Appendix B. The SSP water samples were shipped to various laboratories of the EPA's Contract Laboratory Program (CLP). Analyses were performed for 35 volatile and 67 semivolatile organic compounds, as shown in Tables 3-1 and 3-2.

The compounds detected in the quality assurance sampling are shown in Table 3-3. Twelve of the 17 wells have been found to have detectable contamination. Table 3-3 indicates that 10 volatile and one semivolatile organic compounds have been detected in the groundwater. Also shown is a comparison of the number of wells in which the compounds were detected for the two programs. The use of a lower detection limit in the AB 1803 laboratory analyses, however, has resulted in the identification of contaminants in more wells than in the SSP sampling. One compound, Bis (2-Ethylhexyl) Phthalate, has been detected in seven wells by the SSP sampling, whereas this compound was not detected in the AB 1803 sampling. This compound is a common contaminant associated with laboratory glassware contamination. In general, the results obtained from the two sampling activities compare favorably; and differences are within the precision of current laboratory analysis techniques as discussed in Appendix B.

### 3.1.2 SOURCE SAMPLING

The locations of the 14 wells sampled in the source sampling program are shown in Figure 3-2. As indicated in this figure, the wells are located in and around Azusa, California. Various industries have been located in this area for many years, and many of these industries have reportedly used or disposed of chemical compounds which have been detected in

Table 3-1
LABORATORY: S-CUBED
EPA METHOD 624
PURGEABLE ORGANIC ANALYSES

| | |
|---|---|
| Chloromethane | 1,1,2,2-Tetrachloroethane |
| Bromomethane | 1,2-Dichloropropane |
| Vinyl Chloride | Trans-1,3-Dichloropropene |
| Chloroethane | Trichloroethylene |
| Methylene Chloride | Dibromochloromethane |
| Acetone | 1,1,2-Trichloroethane |
| Carbon Disulfide | Benzene |
| 1,1-Dichloroethylene | Cis-1,3-Dichloropropene |
| 1,1-Dichloroethane | 2-Chloroethyl Vinyl Ether |
| Trans-1,2-Dichlorethylene | Bromoform |
| Chloroform | 2-Hexanone |
| 1,2-Dichloroethane | 4-Methyl-2-Pentanone |
| 2-Butanone | Perchloroethylene |
| 1,1,1-Trichloroethane | Toluene |
| Carbon Tetrachloride | Chlorobenzene |
| Vinyl Acetate | Ethyl Benzene |
| Bromodichloromethane | Styrene |
| | Total Xylenes |

LASG3/035

Table 3-2
LABORATORY: S-CUBED AND ERG
EPA METHOD 625
SEMIVOLATILES
ORGANIC ANALYSES

N-Nitrosodimethylamine
Phenol
Aniline
Bis (2-Chloroethyl) Ether
2-Chlorophenol
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Benzyl Alcohol
1,2-Dichlorobenzene
2-Methylphenol
Bis (2-Chloroisopropyl) Ether
4-Methylphenol
N-Nitro-Dipropylamine
Hexachloroethane
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Demethylphenol
Benzoic Acid
Bis (2-Chloroethoxy) Methane
2,4-Dichlorophenol
1,2,4-Trichlorobenzene
Naphthalene
4-Chloroaniline
Hexachlorobutadiene
4-Chloro-3-Methylphenol
(Para-Chloro-Meta-Cresol)
2-Methylnaphthalene
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2-Chloronaphthalene
2-Nitroaniline
Dimethyl Phthalate
3-Nitroanile
Acenaphthene
2,4-Dinitrophenol
4-Nitrophenol
Dibenzofuran
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Diethylphthalate
4-Chlorophenyl Phenyl Ether
Fluorene
4-Nitroanile
4,6-Dinitro-2-Methylphenol
N-Nitrosodiphenylamine
4-Bromophenyl Phenyl Ether
Hexachlorobenzene
Pentachlorophenol
Anthracene
Di-N-Butylphthalate
Fluorathene
Benzidine
Pyrene
Butyl Benzyl Phthalate
3,3'-Dichlorobenzidine
Benzo (A) Anthralene
Bis (2-Ethylhexyl) Phthalate
Chrysene
Di-N-Octyl Phthalate
Benzo (B) Fluoranthene
Benzo (K) Fluoranthene
Benzo (A) Pyrene
Indeno (1,2,3-CD) Pyrene
Dibenzo (A,H) Anthracene
Benzo (G,H,I) Pyrylene
Acenaphthylene

LASG3/036

Table 3-3
COMPARISON OF COMPOUNDS DETECTED IN AB 1803
AND SSP QUALITY ASSURANCE SAMPLING

| Chemical Compounds Detected | No. of Wells Compound Detected in AB 1803 | No. of Wells Compound Detected In QA Sampling |
|---|---|---|
| Volatiles | | |
| Carbon Tetrachloride | 3 | 3 |
| Chloroform | 3[a] | 1 |
| 1,2-Dichloroethane | 1 | 1 |
| 1,1-Dichloroethane | 2[b] | 0 |
| 1,1-Dichloroethylene | 5[b] | 4 |
| Trans-1,2-Dichloroethylene | 3[b] | 1 |
| Perchloroethylene | 8[b] | 3 |
| Trichloroethylene | 10[b] | 6 |
| 1,1,1-Trichloroethane | 3 | 3 |
| Methylene Chloride | 1 | 1 |
| Semivolatiles | | |
| Bis(2-Ethylhexyl) Phthalate | 0 | 7 |
| No Compounds Detected | 5 | 5 |

[a]Difference is due to a lower detection limit used in AB 1803 program.

[b]Some of this difference is due to the higher detection limit used in the SSP.

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the groundwater. The analyses requested for the source sampling included volatile and semivolatile organic compounds as listed in Tables 3-1 and 3-2, and agricultural chemical compounds and other miscellaneous organic chemicals which are listed in Table 3-4. Additional special analytical services were requested for those compounds identified in Table 3-5. The general uses of these compounds are also identified in this table.

A summary of the results of compounds detected in the source sampling program is presented in Table 3-6. Ten of the 14 wells have detectable levels of contamination. As shown in Table 3-6, eight volatile and two semivolatile organic compounds have been detected. Trichloroethylene is the most common compound detected, and it has been detected in six of the 14 wells sampled. Other compounds, which have been detected in relatively high concentrations, include 1,1,1-Trichloroethane, 1,1-Dichloroethylene, and Perchloroethylene. In general, the concentration of these compounds decreases in a southerly direction as described further in Section 3.1.4.

Most of the special compounds analyzed for have not been detected in the source sampling analysis, with the exception of Freon 113. Freon 113 has been identified at the limit of detection, which is 10 ppb, in Well 08000060.

The analytical procedure used for the perchlorate analysis has been determined to be inappropriate. Nitrate levels above one ppm cause positive interference of the perchlorate analysis. Nitrate levels in the groundwater are generally above one ppm in the areas sampled and range as high as 120 ppm. In addition, evaluation of the analytical procedure by the CDHS Southern California Laboratory determined that the presence of other ions also interferes with the perchlorate analysis.

Table 3-4
LABORATORY: CAMBRIDGE
AGRICULTURAL CHEMICALS
AND MISCELLANEOUS ORGANIC ANALYSES

Alpha-BHC
Beta-BHC
Delta-BHC
Gamma-BHC (Lindane)
Heptachlor
Aldrin
Heptachlor Epoxide
Endosulfan I
Dieldrin
4,4'-DDE
Endrin
Endosulfan II
4,4'-DDD
Endrin Aldehyde
Endosulfan Sulfate
4,4'-DDT
Endrin Ketone
Methoxychlor
Chlordane
Toxaphene
Aroclor-1016
Aroclor-1221
Aroclor-1242
Aroclor-1248
Aroclor-1254
Aroclor-1260

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Table 3-5
ADDITIONAL COMPOUNDS AND THEIR USES ANALYZED
FOR SOURCE SAMPLING

| Compound | Uses[1] |
|---|---|
| Freon 113 | Blowing agents, fire extinguishing agents, and cleaning fluids and solvents. |
| Xylidene | Dye intermediates, organic synthesis, pharmaceuticals. |
| Hydrazine | Rocket propellant, agricultural chemicals, drugs, polymerization catalyst, blowing agent; short-stopping agent, spandex fibers, antioxidants, plating metals on glass and plastics, fuel cells, solder fluxes, scavenger for gases, explosives, photographic developers, corrosion inhibitors, oil-well drilling in soils containing kaolinite, bouyancy agent for undersea salvage, diving equipment, boiler feedwater, and reactor cooling water. |
| Perchlorate | Explosives, jet fuel, and analytical reagent. |
| Selenium | Electronics, xerographic plates, TV cameras, photocells, magnetic computer cores, solar batteries, ceramics, steel and copper, rubber accelerator, catalyst and trace element in animal feeds. |
| Thiourea | Photography and photocopying papers, organic synthesis, rubber accelerator, analytical reagent, amino resins, and mold inhibitor. |
| Aniline | Rubber accelerators and antioxidants, dyes and intermediates, photographic chemicals, isocyanates for urethane foams, pharmaceuticals, explosives, petroleum refining, diphenylamine, phenolics, herbicides, and fungicides. |
| N-nitrosodimethylamine | Rocket fuels, solvents, and rubber accelerator. |

[1]Source: The Condensed Chemical Dictionary, 10th Edition.

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Table 3-6
SUMMARY OF COMPOUNDS DETECTED IN SOURCE SAMPLING

| Chemical Compound | No. of Wells Compound Is Detected | Range of Reported Concentrations (ppb) |
|---|---|---|
| Volatiles | | |
| 1,2-Dichloroethane | 1 | 4 |
| 1,1,1-Trichloroethane | 3 | 12-170 |
| 1,1-Dichloroethylene | 4 | 1-96 |
| Trans-1,2-Dichloroethylene | 2 | 5-110 |
| Trichloroethylene | 6 | 1-1,100 |
| Perchloroethylene | 3 | 29-500 |
| Carbon Tetrachloride | 2 | 5-6 |
| Chloroform | 4 | 1-25 |
| Acetone | 1 | 100 |
| Semivolatiles | | |
| Bis(2-Ethylhexyl) Phthalate | 3 | 60 |
| Di-N-Buthylphthalate | 3 | 10 |
| Special Analytical Service Compounds | | |
| Freon-113 | 1 | 10 |
| No Compounds Detected | 4 | -- |

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If an alternate analytical method can be identified, then resampling will be scheduled to determine if perchlorate is present in the groundwater.

Pesticide and herbicide compounds listed in Table 3-4 were analyzed for in wells 01900027, 01900029, 01902115, 01902117, 01902425, 01901525, and 01900831. These analyses have been conducted because of the use of organic pesticides and herbicides on crops which were grown historically in the source sampling area. The results of these analyses indicate no detectable levels of these compounds.

### 3.1.3 GENERAL SAMPLING

The location of the 47 wells sampled in the general sampling activity are shown in Figure 3-2. Water samples from these wells have been analyzed for volatile and semivolatile organic compounds as listed in Tables 3-1 and 3-2.

A summary of the chemical compounds detected in the general sampling activity is given in Table 3-7. Twenty-eight wells contained detectable levels of contamination. Table 3-7 shows the ranges of concentrations for the compounds detected and the number of wells in which the compounds have been detected. The most frequently detected contaminant is trichloroethylene which has been detected in 16 wells, ranging in concentration from 1 to 130 ppb. Perchloroethylene occurs in 12 of the wells sampled at concentrations ranging from 1 to 134 ppb. Carbon tetrachloride occurs in four of the wells sampled, ranging in concentration from 1 to 7.6 ppb. Other constituents detected are summarized in Table 3-7, and specific analyses by well are given in Appendix B.

In 25 of the wells sampled, volatile organics have been detected. Semivolatile organic compounds have been detected

## Table 3-7
## SUMMARY OF CHEMICAL COMPOUNDS DETECTED IN GENERAL SAMPLING

| Chemical Compound | No. of Wells Compound Is Detected | Range of Reported Concentrations (ppb) |
|---|---|---|
| **Volatiles** | | |
| 1,2-Dichloroethane | 1 | 8 |
| 1,1,1-Trichloroethane | 2 | 7.5-17 |
| 1,1-Dichloroethylene | 2 | 1-1.3 |
| Trans-1,2-Dichloroethylene | 1 | 4.1 |
| Perchloroethylene | 12 | 1-134 |
| Trichloroethylene | 16 | 1-130 |
| Carbon Tetrachloride | 4 | 1-7.6 |
| Chloroform | 4 | 1-4.5 |
| None Detected | 22 | -- |
| **Semivolatiles** | | |
| Bis(2-Ethylhexyl) Phthalate | 1 | 2 |
| Phenol | 6 | 2-10 |
| None Detected | 40 | -- |
| No Compounds Detected | 19 | -- |

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in seven of the wells. A total of 19 wells showed no occurrences of either volatile or semivolatile organic compounds. The results of the general sampling activity, particularly the results indicating the absence of contaminants, have been useful, in conjunction with the historical water quality data, for further delineating the extent of contamination in the San Gabriel Basin, which is discussed in the next section.

### 3.1.4 ANALYSIS OF GROUNDWATER SAMPLING DATA

Results of the AB 1803 sampling program, San Gabriel SSP, data collected by the CDHS through August of 1985, and historical groundwater contaminant data have been compiled into a computerized data base system (CH2M HILL, 1985b). A description of this data base and a printout of the available water quality data is presented in Appendix B. The available groundwater contamination data have been analyzed to evaluate the occurrence and distribution of contaminants in the San Gabriel Basin.

Summary tables have been prepared to show the occurrences of contaminants which exceed EPA proposed Maximum Contaminant Levels (MCL's) and CDHS Action Levels. These are defined as follows:

- Maximum Contaminant Levels (MCL's) for drinking water are federal water quality standards required by the Safe Drinking Water Act. With the passage of the Safe Drinking Water Act, the federal government, through the EPA, was given the authority to set standards for drinking water quality delivered by community water suppliers. MCL's are enforceable standards for organic, inorganic, and radiologic contaminants, which may have "any adverse effect upon the health of persons." Health effects, costs, and other factors are taken into consideration in setting MCL's. The EPA has recently proposed MCL's for many volatile organic compounds, which are expected to be finalized in late 1986.

- California Department of Health Services Action Levels are recommended levels developed to protect public health. Action Levels are based on $10^{-6}$ incremental lifetime cancer risk levels for carcinogens or acceptable daily intakes for noncarcinogens. Action Levels exist for both inorganic and organic contaminants. Action Levels for organic contaminants are frequently lower than MCL's, and Action Levels have been developed for a number of organics for which no MCL's exist.

Contaminants detected at concentrations above proposed MCL's and State Action Levels in the San Gabriel Basin during sampling activities conducted in 1985 include the following:

- Proposed MCL's - 1,1-Dichloroethylene (7 ppb), 1,2-Dichloroethane (5 ppb), Carbon Tetrachloride (5 ppb), and Trichloroethylene (5 ppb)

- State Action Levels - 1,1-Dichloroethylene (6 ppb), 1,2-Dichloroethane (1 ppb), Perchloroethylene (4 ppb), and Trans-1,2-Dichloroethylene (16 ppb).

The proposed MCL's and State Action Levels for Carbon Tetrachloride and Trichloroethylene are set at the same concentration values.

Tables 3-8 and 3-9 list wells sampled for the AB 1803 program having contaminant concentrations which exceed proposed MCL's and State Action Levels, respectively. Tables 3-10 and 3-11 list wells sampled for the SSP program having contaminant

Table 3-8
CONCENTRATIONS OF CONTAMINANTS AT OR EXCEEDING EPA PROPOSED MCL'S DETERMINED BY AB 1803 SAMPLING

| Well No. | 1,1-Dichloroethylene (7 ppb) | 1,2-Dichloroethane (5 ppb) | Carbon Tetrachloride* (5 ppb) | Trichloroethylene* (5 ppb) |
|---|---|---|---|---|
| 01900013 | - | - | - | 9.3 - 12.0 |
| 01901441 | - | - | - | 6.8 |
| 01901695 | - | - | - | 12.0 |
| 81902525 | - | - | - | 5.4 - 12.0 |
| 01901014 | - | - | - | 62.0 |
| 01901013 | - | - | - | 42.0 |
| 01902018 | 20.0 | - | - | 140.0 |
| 01902948 | - | - | - | 9.1 |
| 01902027 | - | - | - | 25.0 |
| 01902017 | - | - | - | 98.0 |
| 01902019 | - | - | - | 25.0 - 31.0 |
| A1900749 | - | - | - | 16.0 |
| 01900356 | - | - | - | 7.7 - 9.3 |
| 01900031 | - | - | 16.0 | 5.0 |
| 08000039 | - | - | 20.0 - 29.0 | - |
| 01900029 | - | 5.3 | 20.0 | 440.0 |
| 01900882 | - | - | - | 52.0 - 108.0 |
| 71900721 | - | - | 14.0 - 17.0 | 39.0 - 111.0 |
| 71903093 | - | - | 7.2 - 13.0 | 17.0 - 76.0 |
| 91901437 | - | - | - | 37.0 |
| 91901439 | - | - | - | 10.0 - 12.0 |
| 51902947 | - | - | 10.4 | - |
| 91901440 | - | - | - | 10.0 |
| 01901599 | - | - | - | 5.1 |
| 01900831 | 78.0 | - | - | 24.0 |
| 01900337 | - | - | - | 8.0 |
| 01901596 | - | - | - | 23.0 |
| 31902819 | 16.0 | - | - | 18.0 |
| 31902820 | - | - | - | 18.0 |

*Proposed MCL's and state action levels are the same.

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Table 3-9
CONCENTRATIONS OF CONTAMINANTS AT OR EXCEEDING STATE ACTION LEVELS DETERMINED BY AB 1803 SAMPLING

| Well No. | 1,1-Dichloroethylene (6 ppb) | 1,2-Dichloroethane (1.0 ppb) | Perchloroethylene (4.0 ppb) | Trans-1,2-Dichloroethylene (16 ppb) |
|---|---|---|---|---|
| 01901681 | - | - | 13.0 | - |
| 01901694 | - | - | 16.0 | - |
| 01902018 | 20.0 | - | 6.0 | - |
| 01902017 | - | - | 8.0 | - |
| 01900121 | - | - | 4.4 | - |
| 01901521 | - | - | 17.0 | - |
| 01900029 | - | 5.3 | 100.0 | - |
| 01900882 | - | 3.7 | 8.9-10.0 | - |
| 71903093 | - | 3.4 | 6.4 | - |
| 91901440 | - | - | 9.4 | - |
| 31902819 | 16.0 | - | 37.0 | - |
| 31902820 | - | - | 37.0 | 16.0 |
| 01902271 | - | - | 15.0 | - |
| 71900721 | - | 4.4 | - | - |
| 91901439 | - | 2.0-2.1 | - | - |
| 01900831 | 78.0 | - | - | - |

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Table 3-10
CONCENTRATIONS OF CONTAMINANTS AT OR EXCEEDING EPA PROPOSED MCL'S DETERMINED BY SAN GABRIEL SSP

| Well No. | 1,1-Dichloroethylene (7 ppb) | 1,2-Dichloroethane (5 ppb) | Carbon Tetrachloride* (5 ppb) | Trichloroethylene* (5 ppb) |
|---|---|---|---|---|
| 01900001 | - | - | - | 5.0 |
| 01900012 | - | - | - | 9.0 |
| 01900029 | - | - | 6.0 | 370.0 |
| 01900035 | - | 8.0 | 7.6 | 130.0 |
| 01900331 | - | - | - | 5.0 |
| 01900337 | - | - | - | 8.0 |
| 01900831 | 25.0 | - | - | 8.0 |
| 01900885 | - | - | - | 6.0 |
| 01901596 | - | - | - | 23.0 |
| 01902032 | - | - | - | 6.6 |
| 01902951 | - | - | - | 11.0 |
| 08000049 | - | - | - | 7.1 |
| 08000060 | 96.0 | - | - | 1100.0 |
| 11900038 | - | - | 5.0 | 600.0 |
| 31902819 | 8.0 | - | - | 12.0 |
| 31902820 | 10.0 | - | - | 14.0 |
| 01900031 | - | - | 5.0 | - |
| 08000039 | - | - | 9.0 | - |

*Proposed MCL's and state action levels are the same.

LASG3/030

Table 3-11
CONCENTRATIONS OF CONTAMINANTS AT OR EXCEEDING STATE ACTION LEVELS
DETERMINED BY SAN GABRIEL SSP

| Well No. | 1,1-Dichloroethylene (6 ppb) | 1,2-Dichloroethane (1.0 ppb) | Perchloroethylene (4.0 ppb) | Trans-1,2-Dichloroethylene (16 ppb) |
|---|---|---|---|---|
| 01900029 | - | 4.0 | 29.0 | - |
| 01900035 | - | 8.0 | 4.8 | - |
| 01900831 | 25.0 | - | - | - |
| 08000049 | - | - | 33.0 | - |
| 08000060 | 96.0 | - | 500.0 | 110.0 |
| 11900038 | 6.8 | - | 480.0 | - |
| 31902819 | 8.0 | - | 42.0 | - |
| 31902820 | 10.0 | - | 46.0 | - |
| 01900331 | - | - | 24.0 | - |
| 01902169 | - | - | 6.0 | - |
| 01902270 | - | - | 10.0 | - |
| 01902806 | - | - | 8.3 | - |
| 01902951 | - | - | 134.0 | - |

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concentrations which exceed proposed MCL's and State Action Levels, respectively. Tables 3-12 and 3-13 summarize wells sampled by the CDHS in the first half of 1985 which have exceeded proposed MCL's and State Action Levels, respectively. Table 3-14 summarizes the number of exceedances for EPA-proposed MCL's and State Action Levels for five of the more commonly occurring contaminants. A total of 46 wells have been identified in 1985 which exceed proposed MCL's for one or more of the following contaminants: 1,1-Dichloroethylene, 1,2-Dichloroethane, Carbon Tetrachloride, and Trichloroethylene. An additional 12 wells has been identified which exceed State Action Levels for one or more of the following compounds: 1,1-Dichloroethylene, 1,2-Dichloroethane, and Perchloroethylene. As described in Section 1.0, steps are being taken by the various water producers to assure that contaminant levels in water supplies are below EPA-proposed MCL's and State Action Levels prior to distribution.

Table 3-15 summarizes the contaminants detected in groundwater as a result of the various sampling activities conducted in 1985. This table indicates that 13 volatile and 3 semivolatile compounds have been detected. In addition, the following agricultural chemicals have been detected as a result of the AB 1803 sampling activities: simazine (Princep) and atrazine (AAtrex). Trichloroethylene and perchloroethylene are the most frequently detected compounds, which occur in 89 and 67 of the 195 wells sampled, respectively. Carbon Tetrachloride occurs in 18 wells. 1,1,1-Trichloroethane, 1,1-Dichloroethylene, and chloroform occur in more than 10 percent of the wells sampled. All other contaminants detected occur in less than 10 percent of the wells sampled in 1985.

Table 3-12
CONCENTRATIONS OF CONTAMINANTS AT OR EXCEEDING EPA PROPOSED MCL'S DETERMINED BY CDHS SAMPLING

| Well No. | 1,1-Dichloroethylene (7 ppb) | 1,2-Dichloroethane (5 ppb) | Carbon Tetrachloride* (5 ppb) | Trichloroethylene* (5 ppb) |
|---|---|---|---|---|
| 01900013 | - | - | - | 7.4 |
| 01900052 | - | - | - | 11.0-21.0 |
| 01900418 | - | - | - | 6.1-12.6 |
| 01900882 | - | - | - | 35.0 |
| 01901013 | - | 8.4 | - | 16.0-47.0 |
| 01901014 | - | - | - | 33.0-83.0 |
| 01901055 | - | - | - | 142.0 |
| 01901441 | - | - | - | 6.8 |
| 01902787 | - | - | - | 9.6 |
| 01902859 | - | - | - | 5.9 |
| 21900749 | - | - | - | 5.2-5.9 |
| 71900721 | - | - | - | 18.4-24.3 |
| 71903093 | - | - | 5.2-7.7 | 5.2-38.0 |
| 91901437 | - | - | - | 15.3-20.5 |
| 91901439 | - | - | - | 5.0-9.7 |
| 51902858 | - | - | 6.7-7.1 | - |
| 51902947 | - | - | 5.5 | - |

*Proposed MCL's and state action levels are the same.

LASG3/031

Table 3-13
CONCENTRATIONS OF CONTAMINANTS AT OR EXCEEDING STATE ACTION LEVELS
DETERMINED BY CDHS SAMPLING

| Well No. | 1,1-Dichloroethylene (6 ppb) | 1,2-Dichloroethane (1.0 ppb) | Perchloroethylene (4.0 ppb) | Trans-1,2-Dichloroethylene (16 ppb) |
|---|---|---|---|---|
| 01900026 | - | - | 4.1-5.1 | - |
| 01900052 | - | - | 7.4 | - |
| 01900882 | - | - | 7.5 | - |
| 01901521 | - | - | 14.0-24.0 | - |
| 01901522 | - | - | 75.0-87.0 | - |
| 01901694 | - | - | 10.0 | - |
| 01902270 | - | - | 7.2 | - |
| 01902271 | - | - | 5.5 | - |
| 01902806 | - | - | 13.0 | - |
| 01902859 | - | - | 6.3 | - |
| 01901013 | - | 8.4 | - | - |
| 01901014 | - | 3.1-3.6 | - | - |

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Table 3-14
SUMMARY OF THE MORE COMMONLY OCCURRING CONTAMINANTS EXCEEDING EPA PROPOSED MCL'S AND STATE ACTION LEVELS AS OF SEPTEMBER 1985

| Contaminant | EPA Proposed MCL* | No. Wells Exceeding EPA Proposed MCL* | California Action Level* | No. Wells Exceeding Action Level* |
|---|---|---|---|---|
| Trichloroethylene | 5 | 43 | 5 | 43 |
| Perchloroethylene | - | - | 4 | 28 |
| Carbon Tetrachloride | 5 | 9 | 5 | 9 |
| 1,1-Dichloroethylene | 7 | 4 | 6 | 5 |
| 1,2-Dichloroethane | 5 | 2 | 1 | 6 |
| Trans-1,2-Dichloro-ethylene | 70[a] | 1 | 16 | 2 |

*Values given in parts per billion.

[a]70 ppb is a proposed Recommended MCL.

LASG4/012

Table 3-15
SUMMARY OF CHEMICAL COMPOUNDS DETECTED
AS A RESULT OF SAMPLING ACTIVITIES CONDUCTED IN 1985

| Compound | Number of Wells Exceeding Detection Limit[a] | Highest Reported Concentration (ppb) |
|---|---|---|
| **Volatiles** | | |
| Trichloroethylene | 89 | 1,100 |
| Perchloroethylene | 67 | 500 |
| 1,1,1-Trichloroethane | 21 | 170 |
| 1,1-Dichloroethylene | 25 | 96 |
| Chloroform | 18 | 25 |
| Carbon Tetrachloride | 18 | 17 |
| Trans-1,2-Dichloroethylene | 10 | 110 |
| Methylene Chloride | 6 | 10 |
| 1,2-Dichloroethane | 7 | 8 |
| 1,1-Dichloroethane | 4 | 8.5 |
| Acetone | 1 | 100 |
| M,P-Xylene | 1 | 0.3 |
| O-Xylene | 1 | 0.2 |
| **Semivolatiles** | | |
| Bis (2-Ethylhexyl) Phthalate | 9 | 60 |
| Phenol | 5 | 10 |
| Di-N-Butylphthalate | 3 | 10 |
| **Agricultural** | | |
| Atrazine (Aatrex) | 4 | 1.67 |
| Simazine (Princep) | 1 | 0.75 |

[a] 195 wells have been sampled in 1985.

LASG4/011

Three contaminants have been selected to evaluate the general extent of contamination in the San Gabriel Basin: Trichloroethylene (TCE), Perchloroethylene (PCE), and Carbon Tetrachloride (CTC). These contaminants have been selected for evaluation based on the following: 1) they are the most frequently occurring contaminants in the basin; 2) they generally have the widest areal distribution; 3) the historical record is more comprehensive for these contaminants; and 4) most of the other contaminants detected occur in association with one or more of these contaminants.

Plate 1 shows the extent of TCE contamination based on sampling data obtained during 1985. The maximum values reported for each well have been used in the construction of this map. If a well has been sampled previously but not in 1985, then the most recent data for the well has been used. As indicated above, the proposed MCL for TCE is 5 ppb. The available data for wells which have been sampled were examined to identify wells which have had maximum reported TCE concentrations in the ranges of less than 5 ppb, 5 to 50 ppb, and greater than 50 ppb. Plate 1 shows the approximate areas encompassing the wells showing maximum observed TCE concentrations falling in each of these ranges.

As shown in Plate 1, TCE contamination is relatively widespread throughout the basin. In general, the extent of contamination is shown to be larger than the areal extent shown previously in Figure 3-1, which was based on a more limited data base. A total of 63 wells lie within the areas shown to be potentially at or above 5 ppb. The highest concentration of TCE is 1,100 ppb which occurs just south of the Santa Fe Flood Control Basin.

The largest single area of contamination occurs to the east of the San Gabriel River. This area appears to be a continuous zone of contamination with the highest concentrations of

TCE located just east of the Santa Fe Flood Control Basin and near Azusa. TCE concentrations range from several hundred ppb in the northern parts of this area, to very low levels (eventually below detection) in the southern portion.

West of the San Gabriel River are two relatively large areas of TCE contamination. The more northerly area is just west of the Santa Fe Flood Control Basin. The highest concentrations of TCE, several hundred ppb, in this area are observed in wells near the confluence of Sawpit Wash and the Rio Hondo. Most of the contamination in this northerly area is at relatively low concentrations. The second area, to the south, occurs approximately parallel to the Rio Hondo and just north of the City of El Monte. Relatively high levels of TCE contamination exceeding several ten's of ppb, have been observed in wells located in this area as indicated by the large area showing TCE concentrations potentially exceeding 5 ppb.

Other areas showing TCE concentrations in excess of proposed MCL's include the following locations: an area between Alhambra and San Gabriel, an area to the northeast of the City of San Gabriel, an area to the north of South El Monte, two areas to the south and southeast of South El Monte, an area in the vicinity of Whittier Narrows, and an area along the San Jose Creek in the Puente Valley. Most of these areas are not well defined because of the lack of additional existing wells which could be sampled in those areas. Possibly, some of the smaller areas defined by one or two wells may be a part of a much larger area of contamination.

The extent of PCE contamination is shown in Plate 2. This map has been constructed in a manner similar to the TCE contamination map. A MCL for PCE is still under evaluation by the EPA; however, the State Action Level for PCE is 4 ppb. As shown in Plate 2, PCE contamination occurs throughout much of the San Gabriel Basin. A total of 45 wells lie within the areas of PCE shown to be potentially at or above 4 ppb. The highest reported concentration of PCE is 500 ppb which occurs just south of the Santa Fe Flood Control Basin.

The largest areal extent of apparent continuous contamination occurs to the east of the San Gabriel River. This area coincides very closely with the large area of TCE contamination described above. The highest concentrations of PCE in this area have exceeded 500 ppb, which occur to the east and south of the Santa Fe Flood Control Basin and south of the City of Azusa. Other wells showing relatively high levels of PCE do occur further to the south; however, there appears to be a general decrease in concentration to the south.

The second largest area of PCE contamination, which appears to represent a continuous zone of contamination, is located in the Puente Valley near its entrance to the San Gabriel Valley. Concentrations of PCE have ranged from 100 to over 300 ppb in this area. Several wells containing concentrations in excess of 4 ppb have been reported.

PCE contamination has also been found in wells in the northeastern part of the basin during 1985 sampling. Contamination in these wells has been reported to range from 10 to 15 ppb. PCE has not been detected in the surrounding wells.

Numerous wells sampled in the basin show detectable levels of PCE contamination west of the San Gabriel River. Approximately 19 apparently separate areas of PCE contamination have been identified. Many of these areas may be a part of a much larger area of contamination; however, available data are insufficient to establish the relation of PCE contamination between many of the wells. Many of these areas are not well defined because of the lack of available wells to sample in the vicinity of these areas.

In comparing Plates 1 and 2, the most significant difference is the absence of TCE and predominance of PCE in an area west of the San Gabriel River and northeast of El Monte. PCE in this area has been shown to exceed 180 ppb. Just west of the PCE contamination, along the Rio Hondo, the predominant contaminant is TCE. In this area, TCE has historically ranged up to approximately 80 ppb. PCE has not been detected historically.

PCE concentration levels in the areas near the confluence of the Puente Valley with the San Gabriel Valley exceed TCE contaminant levels. In some wells, the difference varies by nearly a factor of 10. In general, TCE ranges between about 25 to 50 ppb; whereas PCE ranges between approximately 30 to 330 ppb.

Groundwater contamination by CTC is shown in Plate 3. The EPA proposed MCL for CTC is 5 ppb. The CTC map has been prepared in the same manner as the TCE and PCE maps.

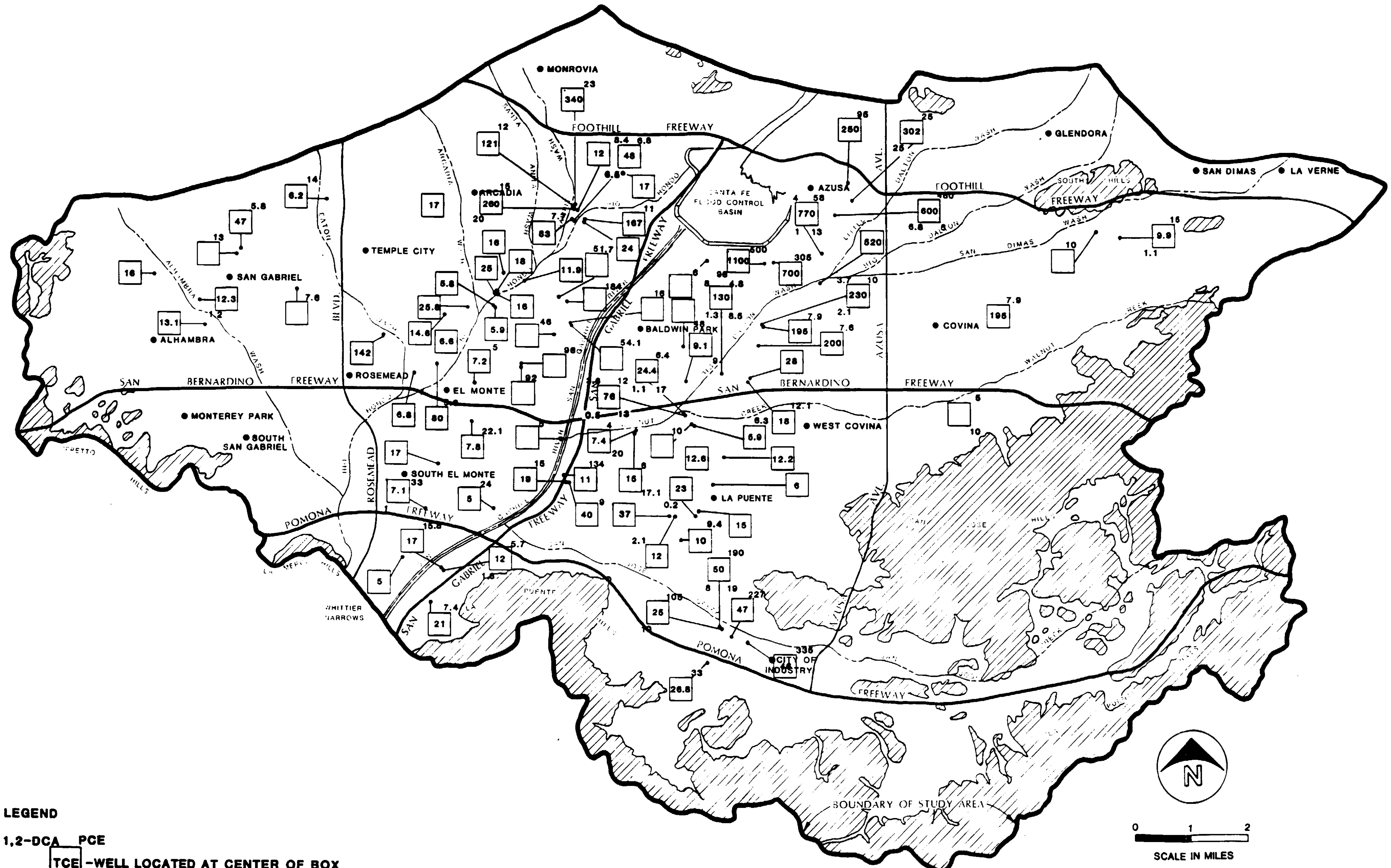
As indicated by Plate 3, the CTC contamination appears to be of lesser areal extent than observed for TCE and PCE. Most of the CTC contamination occurs to the east of the San Gabriel River. In general, CTC concentration levels have not exceeded 50 ppb. The highest concentrations have been observed east of the Santa Fe Flood Control Basin, south of Azusa, and southeast of Baldwin Park. The largest area of CTC contamination occurs within the large areas of TCE and PCE contamination east of the Santa Fe Flood Control Basin as described above.

CTC contamination has been observed in two wells in the western part of the basin indicated by the small areas shown on Plate 3. These occurrences appear to be limited in areal extent, and the CTC concentrations that have been reported are less than 5 ppb. However, additional groundwater sampling will be required to further delineate the extent of CTC contamination in these areas.

Figure 3-3 has been prepared to show the distribution and relation of five of the most frequently occurring contaminants in the San Gabriel Basin. This map shows the highest concentrations historically reported for the following contaminants: TCE, PCE, CTC, 1,1-Dichloroethylene (1,1-DCE) and 1,2-Dichloroethane (1,2-DCA). This map shows that 88 of the 254 wells sampled in the past have at one time exceeded or are currently exceeding EPA proposed MCL's or State Action Levels for one or more of these contaminants. Table 3-16 identifies the wells and well owners which have been affected by this contamination.

The EPA proposed MCL or State Action Level for TCE has been attained or exceeded in more wells than any of the other contaminants, representing 74 of the 88 wells. PCE has exceeded the State Action Level in 56 wells, and CTC has exceeded the EPA proposed MCL in 11 wells. The EPA proposed MCL's or State Action Levels have been attained or exceeded in 7 wells for 1,1-DCE, and 6 wells for 1,2-DCA. In general, the area east of the Santa Fe Flood Control Basin and south of Azusa exhibits contamination consisting of multiple contaminants at relatively high concentrations.

In order to evaluate the depth of contamination in the San Gabriel Basin, the depth for all but 37 of the 88 wells discussed above has been plotted in Figure 3-4. The distribution of wells provides a large areal coverage of the basin, although information on well depth is not available for 37 of the 88 wells. The depth of wells shown in Figure 3-4 ranges from 80 feet at well 01900001 along the San Gabriel River and in the area of the Whittier Narrows, to 1,002 feet at




LEGEND

1,2-DCA PCE

TCE -WELL LOCATED AT CENTER OF BOX UNLESS INDICATED OTHERWISE

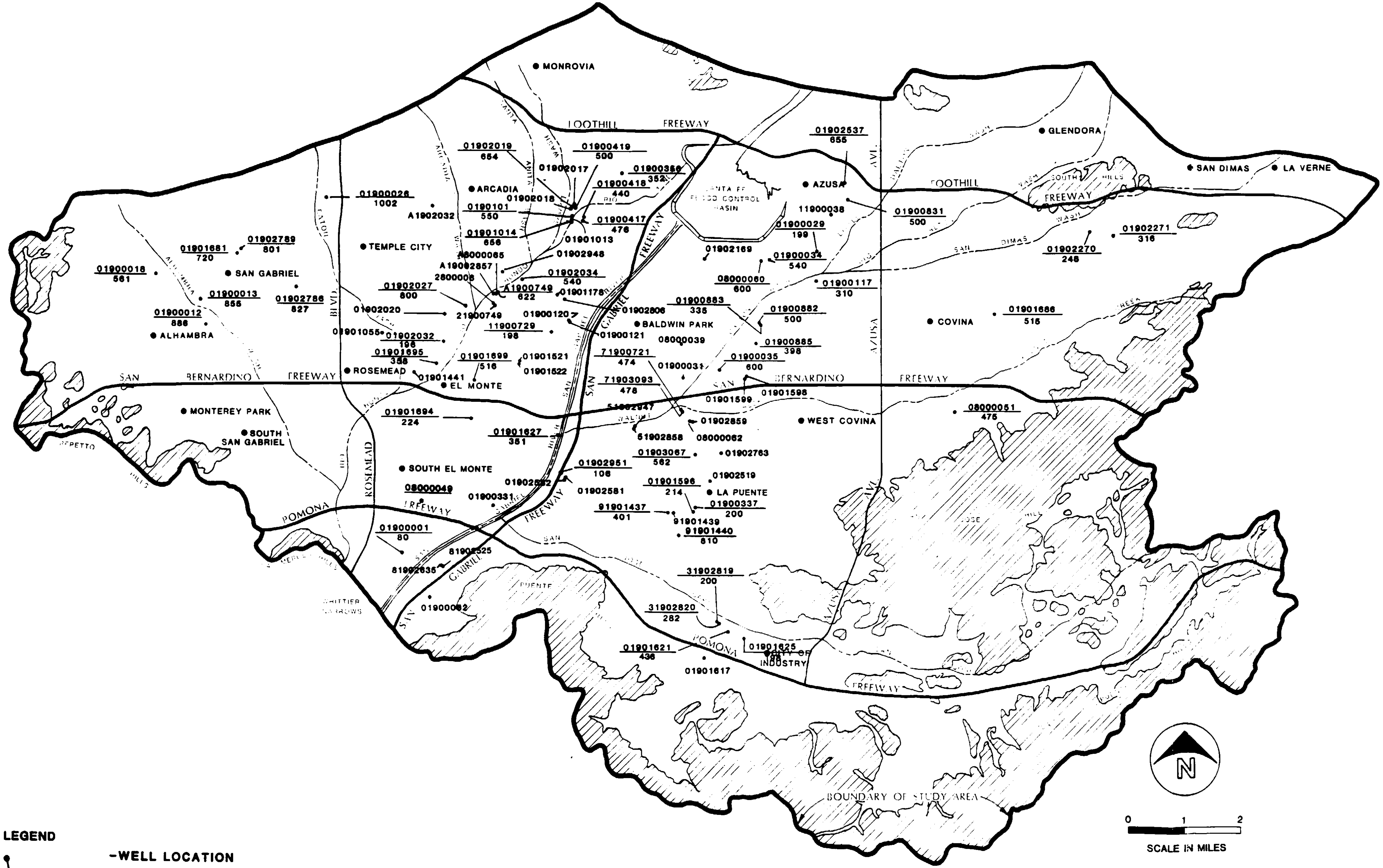
1,1-DCE CTC

CONCENTRATION IN ppb

• -WELL LOCATION

NONWATER-BEARING ROCK

FIGURE 3-3
DISTRIBUTION OF WELLS
WHICH HAVE EXCEEDED EPA PROPOSED
MCL'S OR STATE ACTION LEVELS FOR
TCE, PCE, CTC, 1,1-DCE AND 1,2-DCA
SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM



**LEGEND**

-WELL LOCATION

11900038 -WELL NUMBER

450 -DEPTH OF WELL (IF AVAILABLE)

NONWATER-BEARING ROCK

**FIGURE 3-4**
**DEPTH OF WELLS FOR THOSE WELLS WHICH HAVE EXCEEDED EPA PROPOSED MCL'S OR STATE ACTION LEVELS FOR TCE, PCE, CTC, 1,1-DCE AND 1,2-DCA**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**

Table 3-16
SUMMARY OF GROUNDWATER PRODUCERS THAT HAVE BEEN AFFECTED HISTORICALLY BY
TCE, PCE, CTC, 1,1-DCE, OR 1,2-DCA CONTAMINATION

| | | Maximum Reported Concentrations* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Producer's Name | TDM II Well Code | TCE 1979- -1985 | TCE 1985 | PCE 1979- -1985 | PCE 1985 | CTC 1979- -1985 | CTC 1985 | 1,1-DCE 1985 | 1,2-DCA 1985 |
| AZ-Two, Inc. (also Transit Mix #2) | 11900038 | 600 | 600 | 480 | 480 | 5 | 5 | 6.8 | - |
| Alhambra, City of | 01900012 | 13.1 | 9 | - | - | - | - | - | - |
| Alhambra, City of | 01900013 | 12.3 | 9.3 | - | - | - | - | 1.2 | - |
| Alhambra, City of | 01900018 | 16 | - | - | - | - | - | - | - |
| Alhambra, City of | 01902789 | 47 | - | 5.8 | - | - | - | - | - |
| Arcadia, City of | 01901013 | 48 | 47 | 6.8 | - | - | - | 5.3[1] | 8.4 |
| Arcadia, City of | 01901014 | 83 | 83 | 7.7 | - | - | - | 5.3[2] | - |
| Azusa, City of | 01902537 | 250 | - | 95 | - | - | - | - | - |
| California American Water Company Duarte System | 01900356 | 17 | 7.7 | - | - | - | - | - | - |
| California Water Company - San Marino System | 01901441 | 6.8 | 6.8 | - | - | - | - | - | - |
| California Water Company - San Marino System | 01902787 | 9.6 | 9.6 | 0.86 | 0.86 | - | - | - | - |
| City of Industry | 01902581 | 40 | - | 9 | - | - | - | - | - |
| City of Industry | 01902582 | 19 | - | 15 | - | - | - | - | - |
| Clayton Manufacturing Company | 01901055 | 142 | 142 | - | - | - | - | - | - |
| Covina Irrigating Company | 01900882 | 230 | 108 | 10 | 10 | - | - | 2.1 | 3.7 |
| Covina Irrigating Company | 01900883 | 195 | - | 7.9 | - | - | - | - | - |
| Covina Irrigating Company | 01900885 | 200 | 6 | 7.6 | - | - | - | - | - |
| Covina, City of | 01901686 | 195 | - | 7.9 | - | - | - | - | - |
| Del Rio Mutual Water Company | 01900331 | 5 | 5 | 24 | 24 | - | - | - | - |
| El Monte, City of | 01901694 | 10 | 10 | 22.1 | 16 | - | - | - | - |
| El Monte, City of | 01901695 | 80 | 12 | 5.6 | - | - | - | - | - |
| El Monte, City of | 01901699 | 7.2 | - | 5 | - | - | - | - | - |
| Glendora, City of | 01900831 | 302 | 8 | 25 | - | - | - | 25 | - |
| Hemlock Mutual Water Company | 01901178 | - | - | 51.7 | - | - | - | - | - |
| Hemlock Mutual Water Company | 01902806 | - | - | 184 | 13 | - | - | - | - |
| La Puente Valley County Water District | 01902859 | 5.9 | 5.9 | 6.3 | 6.3 | - | - | - | - |
| Manning Brothers | 01900117 | 520 | - | - | - | - | - | - | - |
| Monrovia, City of | 01900417 | 24 | - | - | - | - | - | - | - |
| Monrovia, City of | 01900418 | 167 | 12.6 | 11 | - | - | - | - | - |
| Monrovia, City of | 01900419 | 12 | - | - | - | - | - | - | - |
| Polopolus, et al. | 01902169 | - | - | 6 | 6 | - | - | - | - |
| Richwood Mutual Water Company | 01901521 | - | - | 96 | 24 | - | - | - | - |
| Richwood Mutual Water Company | 01901522 | - | - | 92 | 87 | - | - | - | - |
| Rose Hills Memorial Park Association | 01900052 | 21 | 21 | 7.4 | 7.4 | - | - | - | - |
| Rurban Homes Mutual Water Company | 01900120 | - | - | 16 | - | - | - | - | - |
| Rurban Homes Mutual Water Company | 01900121 | - | - | 54.1 | 4.4 | - | - | - | - |
| San Gabriel County Water District | 01902786 | - | - | 7.6 | - | - | - | - | - |
| San Gabriel Valley Water Company | 11900729 | - | - | 46 | - | - | - | - | - |
| San Gabriel Valley Water Company | 21900749 | 5.9 | 5.9 | - | - | - | - | - | - |
| San Gabriel Valley Water Company | 28000065 | 5.8 | - | - | - | - | - | - | - |
| San Gabriel Valley Water Company | 51902858 | 15 | - | 6 | - | 17.1 | 7.1 | - | - |
| San Gabriel Valley Water Company | 51902947 | 7.4 | - | 4 | - | 20 | 5.5 | - | - |
| San Gabriel Valley Water Company | 71900721 | 24.4 | 24.3 | 6.4 | - | 17 | 17 | 1.1 | - |
| San Gabriel Valley Water Company | 71903093 | 76 | 76 | 12 | 6.4 | 13 | 13 | 0.5 | 3.6 |
| San Gabriel Valley Water Company | 81902525 | 12 | 12 | 5.7 | - | - | - | 1.3 | - |

Table 3-16 (Continued)

| Producer's Name | TDM II Well Code | Maximum Reported Concentrations* TCE 1979-1985 | TCE 1985 | PCE 1979-1985 | PCE 1985 | CTC 1979-1985 | CTC 1985 | 1,1-DCE 1985 | 1,2-DCA 1985 |
|---|---|---|---|---|---|---|---|---|---|
| San Gabriel Valley Water Company | 81902635 | 17 | - | 15.8 | - | - | - | - | - |
| San Gabriel Valley Water Company | 91901437 | 37 | 37 | - | - | - | - | - | - |
| San Gabriel Valley Water Company | 91901439 | 12 | 12 | - | - | - | - | - | 2.1 |
| San Gabriel Valley Water Company | 91901440 | 10 | 10 | 9.4 | 9.4 | - | - | - | - |
| San Gabriel Valley Water Company | A1900749 | 16 | 16 | - | - | - | - | - | - |
| San Gabriel Valley Water Company | A1902857 | 25 | - | - | - | - | - | - | - |
| San Gabriel Valley Water Company | A8000065 | 18 | - | - | - | - | - | - | - |
| South Pasadena, City of | 01901681 | - | - | 13 | 13 | - | - | - | - |
| Southern California Water Company - San Gabriel | 01902017 | 340 | 98 | 23 | 8 | - | - | - | - |
| Southern California Water Company - San Gabriel | 01902018 | 260 | 140 | 15 | 6 | - | - | 20 | - |
| Southern California Water Company - San Gabriel | 01902019 | 121 | 31 | 12 | - | - | - | - | - |
| Southern California Water Company - San Gabriel | 01902020 | 14.6 | - | - | - | - | - | - | - |
| Southern California Water Company - San Gabriel | 01902027 | 25.8 | 25 | - | - | - | - | - | - |
| Southern California Water Company - San Gabriel | 01902032 | 6.6 | 6.6 | - | - | - | - | - | - |
| Southern California Water Company - San Gabriel | 01902034 | 11.9 | - | - | - | - | - | - | - |
| Southern California Water Company - San Gabriel | 01902948 | 16 | 9.1 | - | - | - | - | - | - |
| Southern California Water Company - San Gabriel | A1902032 | 17 | - | - | - | - | - | - | - |
| Southern California Water Co. San Dimas Dist. | 01902270 | - | - | 10 | 10 | - | - | - | - |
| Southern California Water Co. San Dimas Dist. | 01902271 | 9.9 | - | 15 | 15 | - | - | 1.1 | - |
| Southwest Suburban Water System | 01900337 | 15 | 8 | - | - | - | - | 0.7 | - |
| Southwest Suburban Water System | 01901596 | 23 | 23 | - | - | - | - | 0.2 | - |
| Southwest Suburban Water System | 01901598 | 28 | - | - | - | - | - | - | - |
| Southwest Suburban Water System | 01901599 | 18 | 5.1 | 12.1 | - | - | - | - | - |
| Southwest Suburban Water System | 01901617 | 26.8 | - | 33 | - | - | - | - | - |
| Southwest Suburban Water System | 01901621 | 47 | - | 227 | - | - | - | - | - |
| Southwest Suburban Water System | 01901625 | 46 | - | 335 | - | - | - | - | - |
| Southwest Suburban Water System | 01901627 | - | - | 5 | - | - | - | - | - |
| Southwest Suburban Water System | 01902519 | 6 | - | - | - | - | - | - | - |
| Southwest Suburban Water System | 01902763 | 12.2 | - | - | - | - | - | - | - |
| Southwest Suburban Water System | 01903067 | 12.6 | - | - | - | - | - | - | - |
| Southwest Suburban Water System | 31902819 | 50 | 12 | 190 | 42 | 19 | - | 8 | - |
| Southwest Suburban Water System | 31902820 | 25 | 14 | 105 | 46 | - | - | 10 | - |
| Sunny Slope Water Company | 01900026 | 6.2 | - | 14 | 5.1 | - | - | - | - |
| Texaco Inc. | 01900001 | 5 | 5 | - | - | - | - | - | - |
| Tyler Nursery | 08000049 | 7.1 | 7.1 | 33 | 33 | - | - | 1 | - |
| Valencia Heights Water Company | 08000051 | - | - | 5.0 | - | 10 | - | - | - |
| Valley County Water District | 01900029 | 770 | 370 | 58 | 29 | 13 | 6 | 1 | 4 |
| Valley County Water District | 01900031 | 9.1 | 5.0 | - | - | 9 | 5 | - | - |
| Valley County Water District | 01900034 | 700 | - | 305 | - | - | - | - | - |
| Valley County Water District | 01900035 | 130 | 130 | 4.8 | 4.8 | 8.5 | 7.6 | 1.3 | 8 |
| Valley County Water District | 08000039 | - | - | - | - | 48 | 9 | - | - |
| Valley County Water District | 08000060 | 1100 | 1100 | 500 | 500 | - | - | 96 | - |
| Ward Duck Company | 01902951 | 11 | 11 | 134 | 134 | - | - | - | - |

*Concentration values are parts per billion

[1]1,1-DCE has been detected in 1984 at a maximum concentration of 6.5 ppb

[2]1,1-DCE has been detected in 1984 at a maximum concentration of 5.2 ppb

LASG3/038

well 01900026 in the northwestern part of the basin, northwest of Temple City. Available well completion details for these wells are presented in Appendix B. Based on this map, the depth of contamination may be expected to range over the variation in the depth of the wells. Available information is insufficient to determine if contamination occurs near the top or bottom of the well, or if the contamination is evenly distributed over the entire length of the well. Insufficient data are available to delineate the vertical variation of contamination in the areas of identified groundwater contamination.

The time variation in contaminant concentrations for TCE, PCE, CTC, 1,1-DCE, and 1,1,1-Trichloroethane (1,1,1-TCA) has been generated and plotted on Plate 4. This plate shows the variation in contaminant concentrations from 1979 through 1985 for 90 wells distributed throughout the basin. These wells have been selected based on the available historical record and to provide as complete an areal coverage of the basin as possible. Most wells in the basin have a very short period of record. In addition, wells showing nondetectable levels of contamination as determined in 1985 are shown on Plate 4.

The following trends have been identified based on an examination of Plate 4: increasing concentrations of contamination, decreasing concentrations of contaminants, variable or erratic contaminant concentrations, and relatively steady concentrations of contaminants. The latter trend, relatively steady contaminant concentrations, appears to be the prevalent trend shown by most of the wells sampled.

Increasing contaminant concentrations in the large area of groundwater contamination east of the San Gabriel River is observed in the following wells:

01900035
01900031
71900721
71903093
01901439
01900337
01901596

Generally decreasing contaminant concentrations in this area include wells 01902537, 01900885, and 01902763. Variable or erratic fluctuations in concentrations in this area are observed in wells 01900831, 08000060, and 91901437.

West of the San Gabriel River, and in the large contaminated areas, the following wells tend to exhibit a trend of increasing concentration of contaminants: 01901014, 01901013, 01902030, 01901055. Well 01901695 shows a general decrease in contaminant concentrations. Wells exhibiting an erratic variation in concentrations include 01900417, 01900418, and 01900419.

Two wells west of Arcadia show a general increase in contaminant concentrations. These wells are 01900026 and 01902789. Three wells near Whittier Narrows show a trend of increasing contaminant concentrations. These include 019000331, 81902525, and 01900052.

## 3.2 GROUNDWATER FLOW MODELING

The hydrology and groundwater flow conditions in the San Gabriel Basin are relatively complex; the water storage and transmitting properties of the alluvium are variable throughout the basin. The water budget of the basin consists of many groundwater inflow and outflow components, which vary temporally and spatially. The complexities of the hydrogeology and groundwater flow conditions can be understood and analyzed best by the use of numerical modeling techniques. The CDWR (1966) developed a two-dimensional groundwater flow model of the basin to assist them in understanding the basin's response to stresses such as recharge and pumping. A three-dimensional model developed by the U.S. Geological Survey (USGS) (McDonald and Harbaugh, 1984) has been selected for this investigation to evaluate groundwater flow in the San Gabriel Basin.

### 3.2.1 APPROACH

The modeling approach employed as a part of the San Gabriel SSP involves two types of model analysis. The first analysis involves the development of a two-dimensional cross-sectional model to evaluate the vertical dynamics of groundwater flow in the San Gabriel Basin. Building upon this analysis, a three-dimensional model of the basin has been constructed to evaluate groundwater flow conditions in the basin.

At this stage in the investigation of the San Gabriel Basin, it is important to develop an understanding of the hydrogeology and groundwater flow conditions on a regional scale. The regional scale evaluation is used to assess the large-scale hydrogeologic features and water budget components which affect the general rate and direction of groundwater movement in the basin. The regional scale of analysis necessarily requires the averaging of smaller scale hydrogeologic features (and properties) and water budget components over large areas. The results of the regional scale analysis, however, provide a foundation for conducting further, more refined, analysis at smaller scales. For example, the results of a regional groundwater flow model may be used to provide boundary conditions for a smaller scale and refined groundwater flow model which can be used to investigate groundwater flow paths through an area having highly variable hydrogeologic properties. The goal of this report has been to develop a regional scale groundwater flow model for the San Gabriel Basin which will provide the framework for conducting more refined and local scale modeling during the RI/FS. The results of the regional scale model and applications of the modeling results can be used to aid in planning further RI/FS investigation activities.

The three-dimensional regional scale numerical model of groundwater flow in the San Gabriel Basin was developed, accounting for the following features of the basin:

- The geometry of the alluvial aquifer
- The spatial variation in the hydrogeologic properties of the alluvial aquifer
- The spatial and temporal variation in the magnitudes of recharge from precipitation, streambed percolation, and at spreading grounds
- Groundwater pumping
- Groundwater discharge to rivers
- Subsurface flow from adjacent basins

The model was calibrated using available water level and water budget information for the period from the 1977-1978 water year (October 1977 through September 1978) through June 1984. The calibrated model was used to assess the directions and rates of groundwater flow in the San Gabriel Basin.

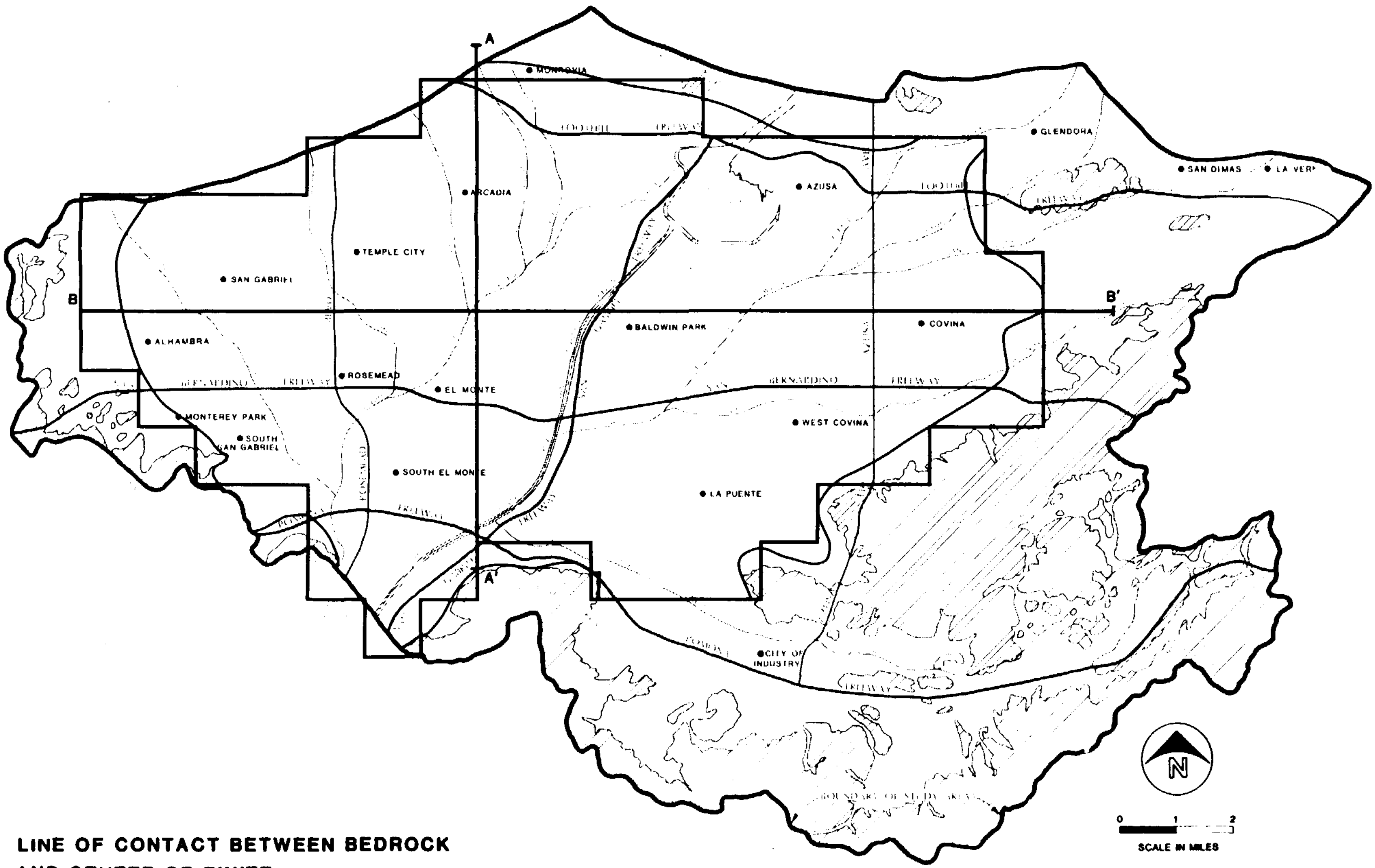
The calibrated model aided the accomplishment of several of the objectives of the SSP. The model has provided the means to integrate and analyze the sizeable data base of hydrogeologic information that has been developed. It has also provided a tool for studying the basin's response of groundwater levels to pumping and recharge. In addition, it has been used to identify and evaluate existing data gaps.

The results of the model analysis have been used to provide input to the identification of potential source areas of contamination and to assess the potential migration of contaminants. Finally, the calibrated three-dimensional model will provide the foundation for the analysis of remedial action alternatives during the RI/FS. The modeling analysis and assumptions, results, and applications are described in more detail in Appendix A.

### 3.2.2 DESCRIPTION OF MODEL

Analysis of the regional hydrogeology, discussed in Section 2.4, provides the basis for the selection of the area to be modeled. The model area is shown in Figure 3-5. The hydrologic boundaries of the modeled area are the Raymond fault on the northwest; the Duarte fault on the north; the bedrock high in the vicinity of South Hills to the northeast; the tertiary bedrock comprising the San Jose hills to the southeast, and the Repetto and Merced hills to the west and southwest; and the mouth of Puente Valley and Whittier Narrows to the south.

Although groundwater contamination occurs within the Puente Valley, the regional scale of the model prevented the meaningful inclusion of the Puente Valley in the model. Because of the relatively shallow depth to bedrock and the fairly straightforward groundwater flow pattern, analytical methods




LEGEND

LINE OF CONTACT BETWEEN BEDROCK AND CENTER OF FINITE DIFFERENCE LAYER 1

EXTENT OF AQUIFER IN FINITE DIFFERENCE LAYER 1

A ⊢—⊣ A' LINE OF CROSS SECTION ON FIGURE A-27

NONWATER-BEARING ROCK

FIGURE 3-5
HORIZONTAL DISCRETIZATION OF LAYER 1
SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM

based on water level maps may be used at this stage of the investigation to evaluate the movement of contaminants in Puente Valley.

In the horizontal plane, the model area is represented by a block-centered finite-difference grid (see Appendix A). This grid consists of 17 columns and 11 rows of cells. Each cell is a square, one mile on a side. There are 112 active cells, in which groundwater flow is simulated, inside the model area in the upper layer. Cells which occupy bedrock material or are outside of the boundaries are inactive (i.e., groundwater flow is not simulated).

In order to account for the vertical variation in the geometry and hydrologic properties in the basin, the finite-difference grid has been divided into four layers. The upper layer, or layer 1, is 400 feet thick. Layers 2, 3, and 4 are 500, 600, and 900 feet thick, respectively. Because of the asymmetrical bowl shape of the alluvial aquifer, each of the lower layers has progressively fewer active cells. Because the land surface elevation and water table elevations are higher in the eastern part of the basin, all four layers are tilted so that they dip to the west at a slope of approximately 12.8 feet/mile.

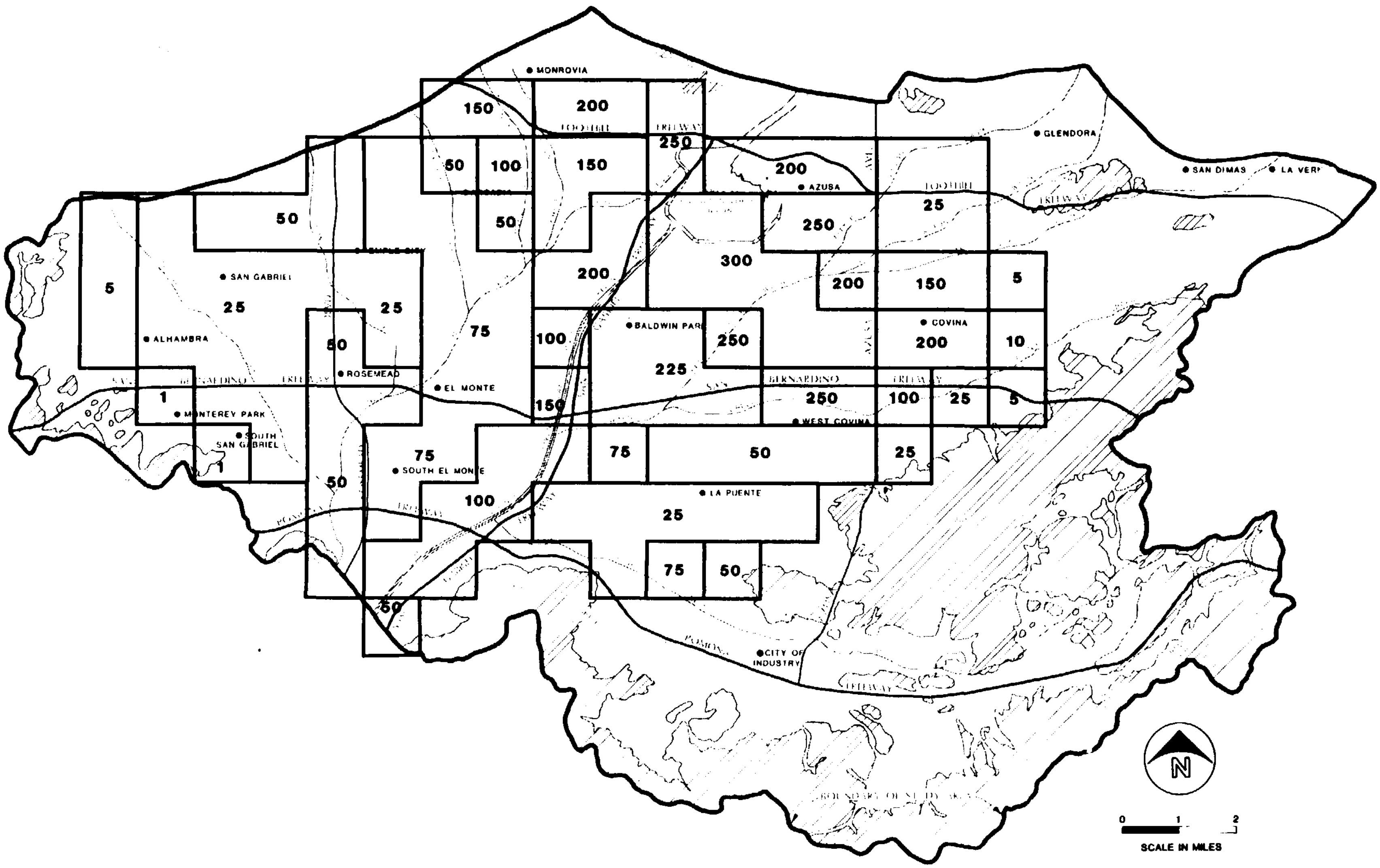
Subsurface groundwater flow into and out of the basin was simulated using a general boundary condition. That is, groundwater levels at the boundaries of the model are allowed to fluctuate in response to recharge and discharge conditions inside the modeled area. This method allows the flow rate into or out of the model area to vary with changing water levels within the model and at the boundary (McDonald and Harbaugh, 1984). Boundary water levels which are defined at some distance from the modeled area boundaries have been taken from LACFCD water table maps.

Recharge from precipitation, estimated in a groundwater budget analysis, has been distributed nonuniformly throughout the modeled area of the basin. The distribution has been based on estimates of soil infiltration rates (CDWR 1966) and land cover characteristics determined from aerial photography (US EPA, 1976). Recharge from precipitation, riverbed leakage, and artificial recharge at spreading basins have been applied directly to the appropriate locations (see Appendix A).

The distribution and rates of groundwater extraction by wells have been based on quarterly records of the Main San Gabriel Basin Watermaster (1977 through 1984).

The distribution of storativity and specific yield has been based on analyses conducted by the CDWR (1966). Values for the zonation of hydraulic conductivity have been based on an analysis of over 80 aquifer and specific capacity tests and a review of over 650 lithologic well logs. Hydraulic conductivity values and specific yield values have been refined during the calibration process, which is described in detail in Appendix A. The resulting distribution of hydraulic conductivity, for example, is shown in Figure 3-6. Based on the results of a two-dimensional vertical cross-section model also discussed in Appendix A, the ratio of horizontal to vertical hydraulic conductivity has been estimated to be approximately 2:1.

Groundwater discharge to rivers has been included in the simulations, with consideration given to the nature of the river bottom, elevation and hydrogeologic properties, and the stage in the river. Specific details of the simulation of groundwater and river interaction are described in Appendix A.




LEGEND

[75] HYDRAULIC CONDUCTIVITY ZONE, FT/D

NONWATER-BEARING ROCK

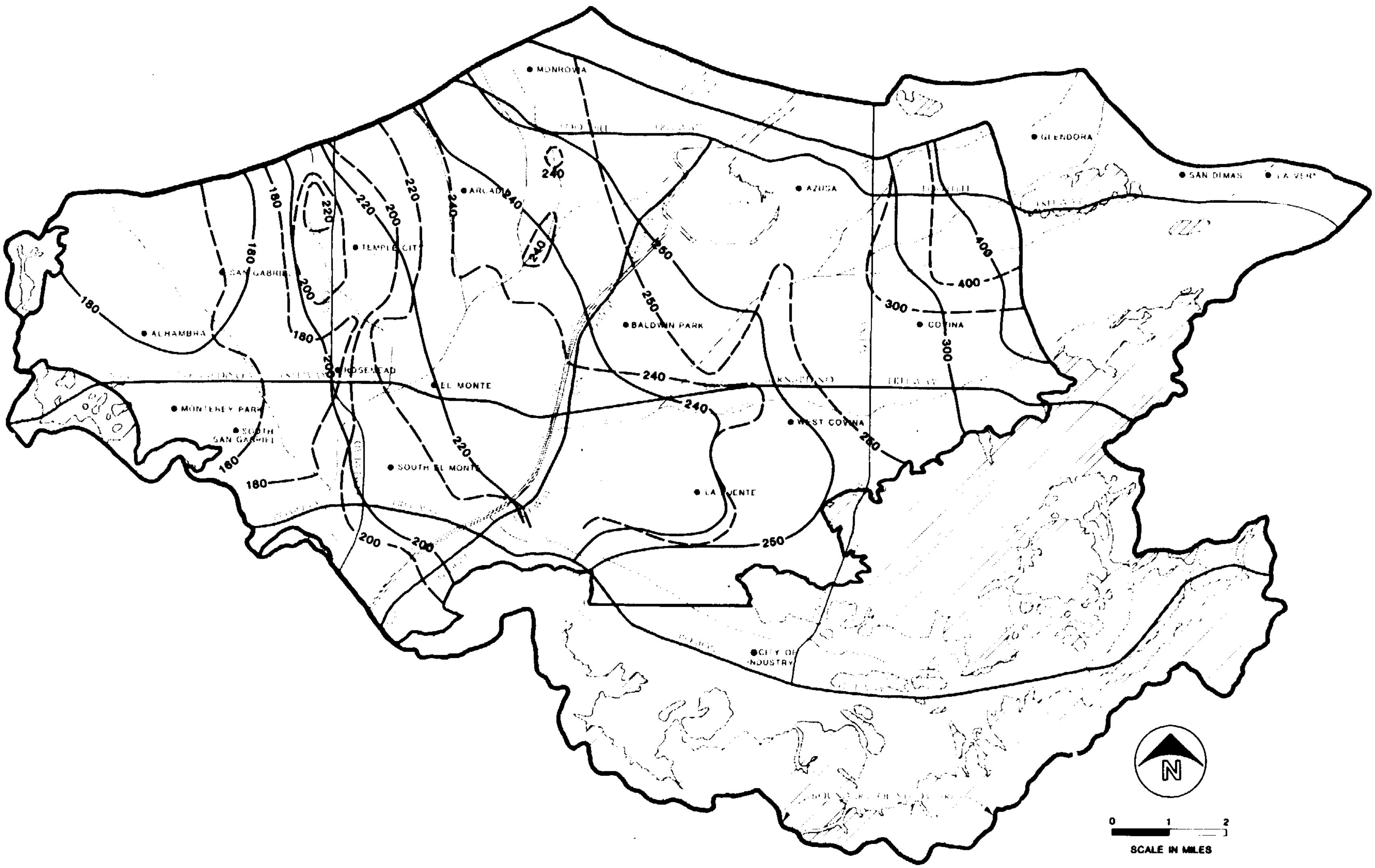
FIGURE 3-6
REFINED HYDRAULIC CONDUCTIVITY ZONATION
SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM

### 3.2.3 RESULTS OF MODEL SIMULATIONS

Figure 3-7 compares the water levels simulated for the Fall of 1982 with the water levels observed by the LACFCD. In general, the agreement is quite good. In fact, for the 5 years of the simulation period for which water level maps are available, the average standard error or root mean squared error (RMSE) between the simulated and observed Fall water table maps is approximately 11 feet. This is an error that is small compared with the spatial and temporal range of water level variations in the basin. For example, water level contour intervals vary from 10 to 100 feet due to the variations in groundwater level gradients.

In order to evaluate the performance of the model's response to time varying water levels, nine wells for which monthly water level information is available have been selected for comparison. Figure 3-8 shows the locations of these wells. Figures 3-9a, b, and c compare the water levels measured at these wells with the simulated water levels observed at these locations. In general, the comparison is favorable. The trend of water level fluctuations in the basin is simulated accurately at all of the sites. Water levels generally agree to within about 10 feet which is a small discrepancy considering that observed water levels in the basin varied by as much as 85 feet during the simulation period. The average RMSE at these wells is about 8 feet.

Groundwater flow across the lateral subsurface boundaries of the model area have been compared with the flow calculated in the groundwater budget analysis (Appendix A). In addition, the quantities of estimated and simulated groundwater discharge to rivers for each water year of the simulation have been compared. In general, the comparison is favorable. The differences are within the level of uncertainty in the variables used to calculate the estimates developed in the




LEGEND

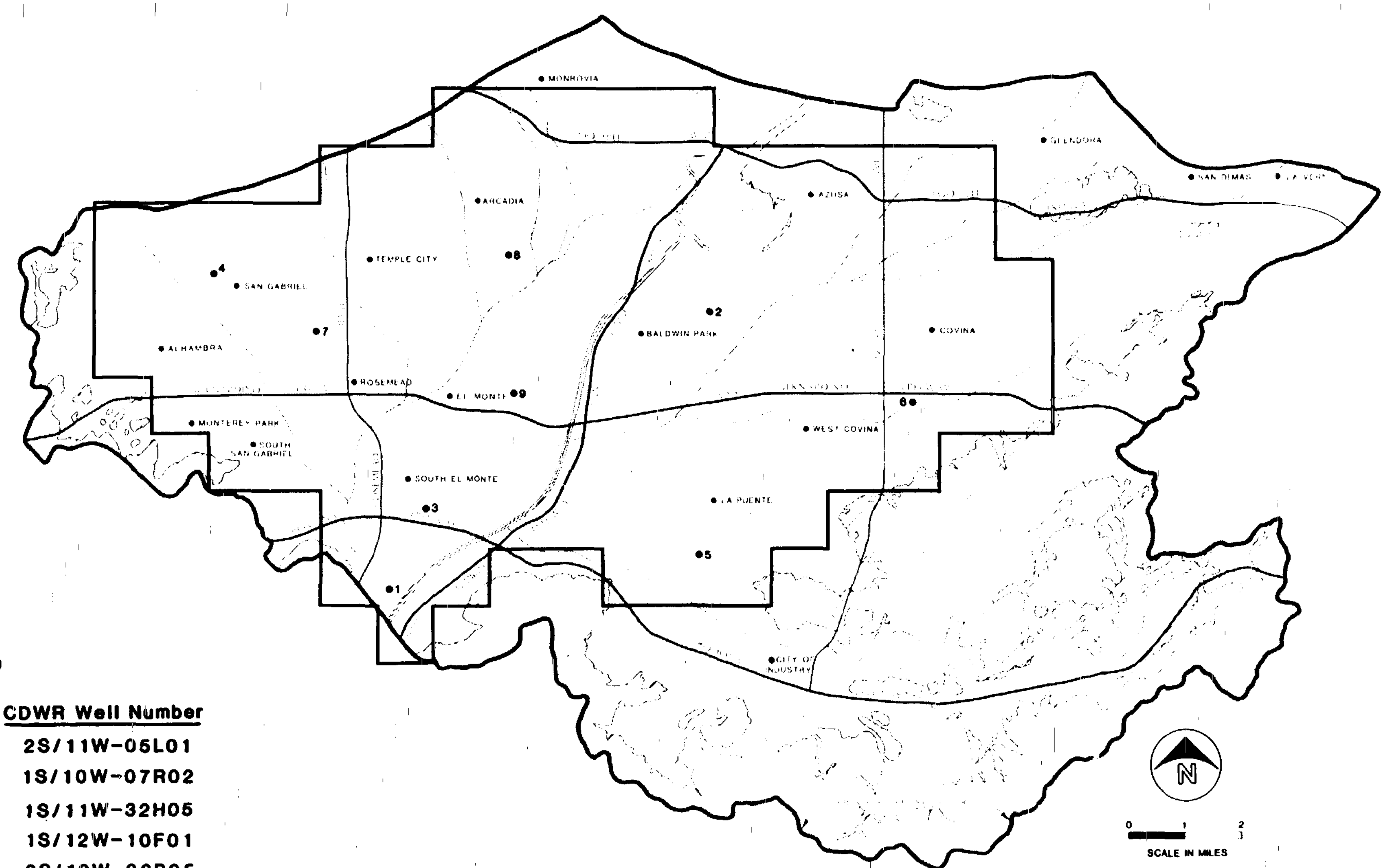
— 250 — SIMULATED WATER LEVELS

- - 250 - - OBSERVED WATER LEVELS (LACFCD, FALL 1982)

MODEL AREA

NONWATER-BEARING ROCK

**FIGURE 3-7**
**COMPARISON OF OBSERVED AND SIMULATED WATER LEVELS, FALL 1982**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**




**LEGEND**

| Well | | CDWR Well Number |
|---|---|---|
| 1 | - | 2S/11W-05L01 |
| 2 | - | 1S/10W-07R02 |
| 3 | - | 1S/11W-32H05 |
| 4 | - | 1S/12W-10F01 |
| 5 | - | 2S/10W-06B05 |
| 6 | - | 1S/10W-23F01 |
| 7 | - | 1S/12W-13H01 |
| 8 | - | 1S/11W-03P02 |
| 9 | - | 1S/11W-22F02 |

NONWATER-BEARING ROCK

**FIGURE 3-8**
**LOCATION OF CALIBRATION WELLS**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**

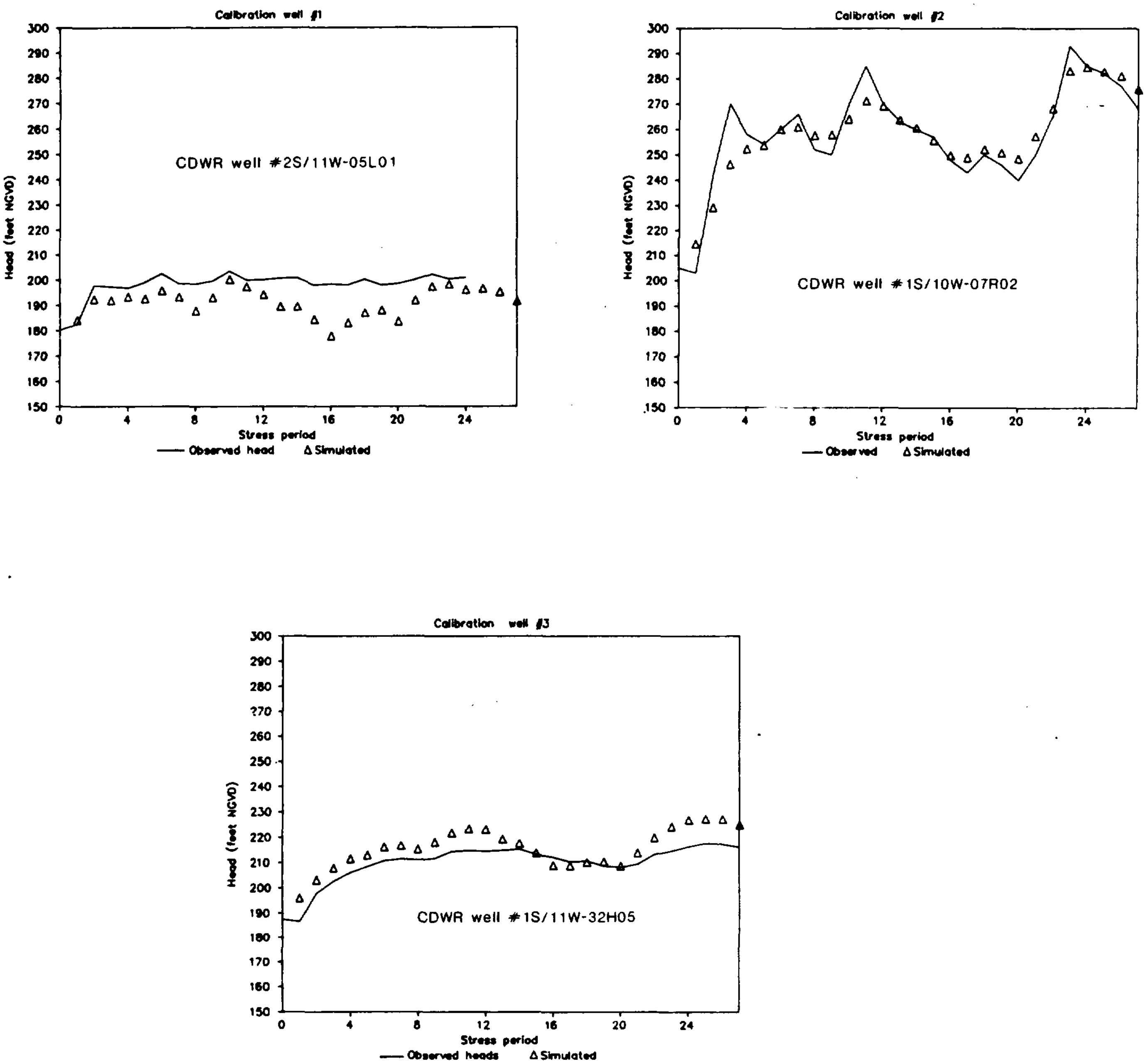



**FIGURE 3-9(a)**
**OBSERVED AND SIMULATED HYDROGRAPHS AT CALIBRATION WELLS 1, 2, and 3.**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**

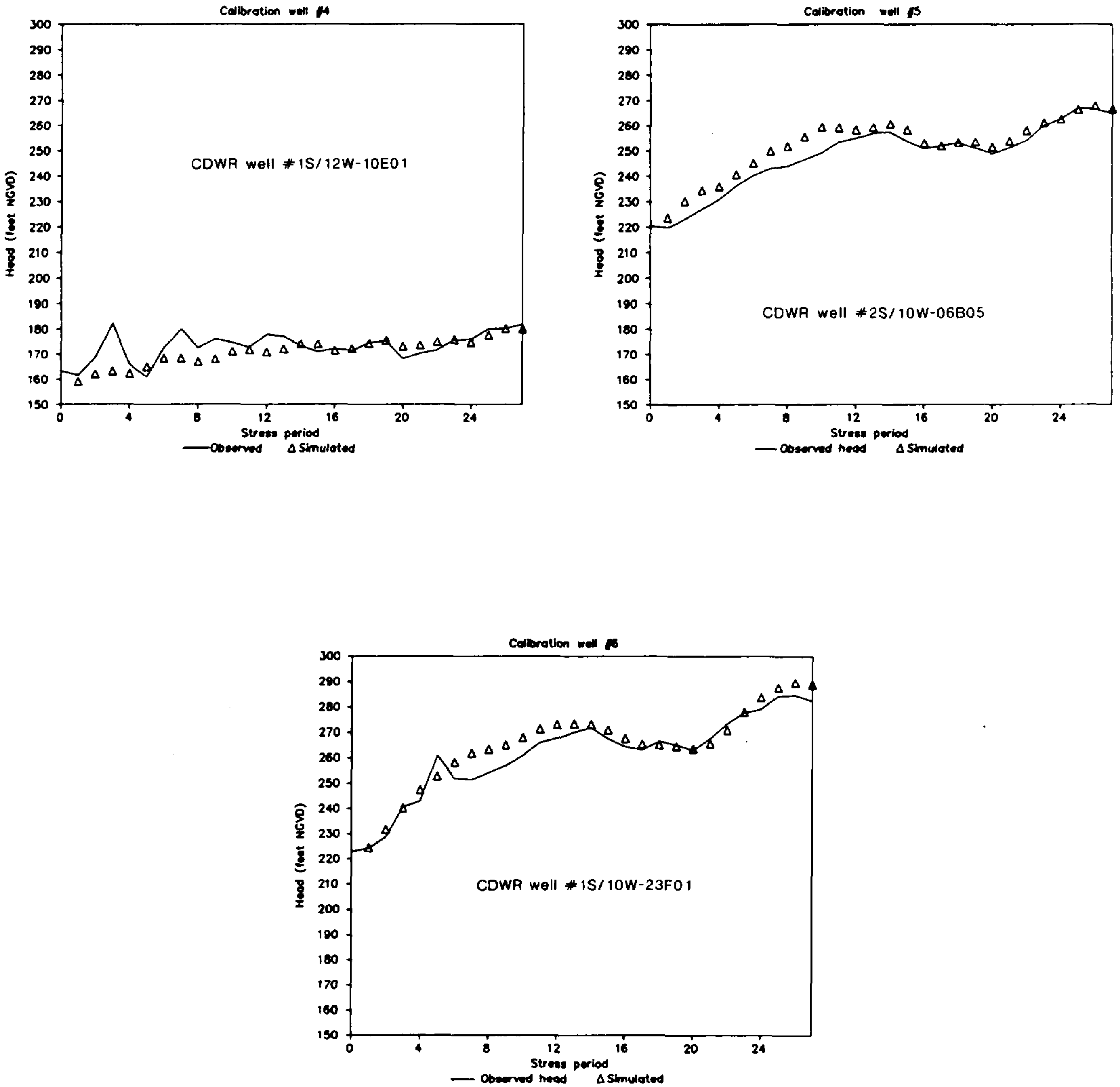
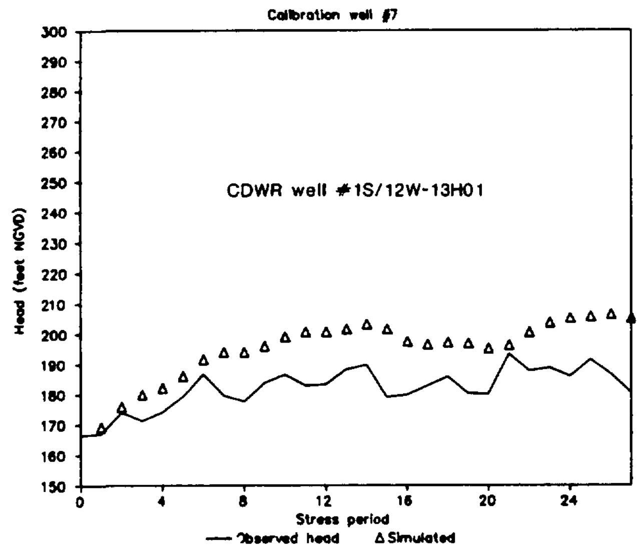
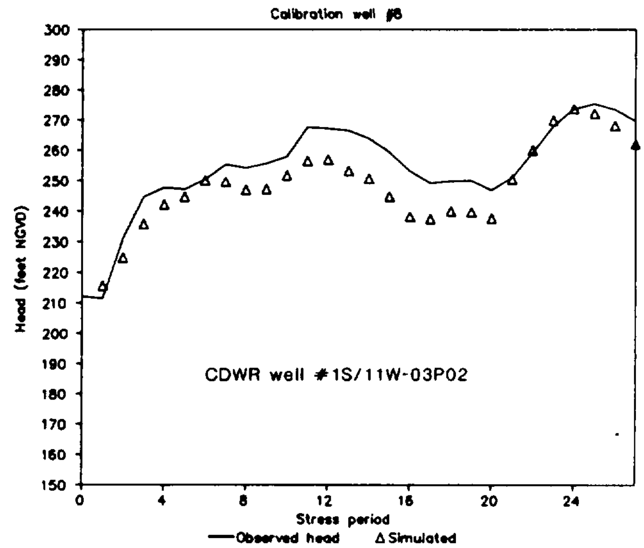



**FIGURE 3-9(b)**
**OBSERVED AND SIMULATED HYDROGRAPHS AT CALIBRATION WELLS 4, 5, and 6.**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**



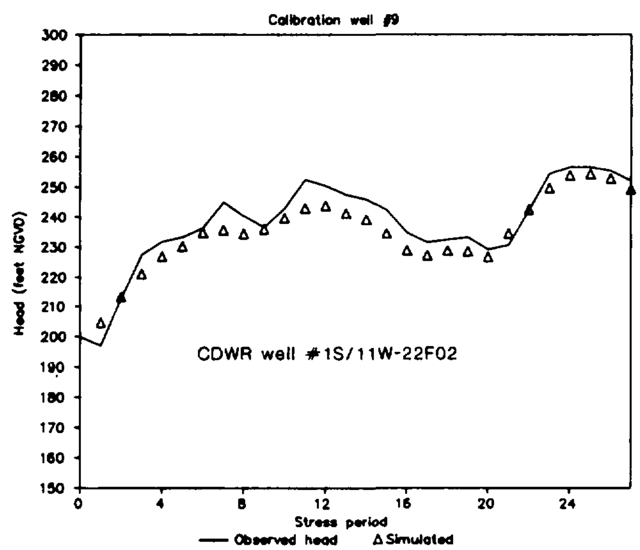




**FIGURE 3-9(c)**
**OBSERVED AND SIMULATED HYDROGRAPHS AT CALIBRATION WELLS 7, 8, and 9.**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**

groundwater budget analysis. This portion of the analysis is discussed in more detail in Appendix A.

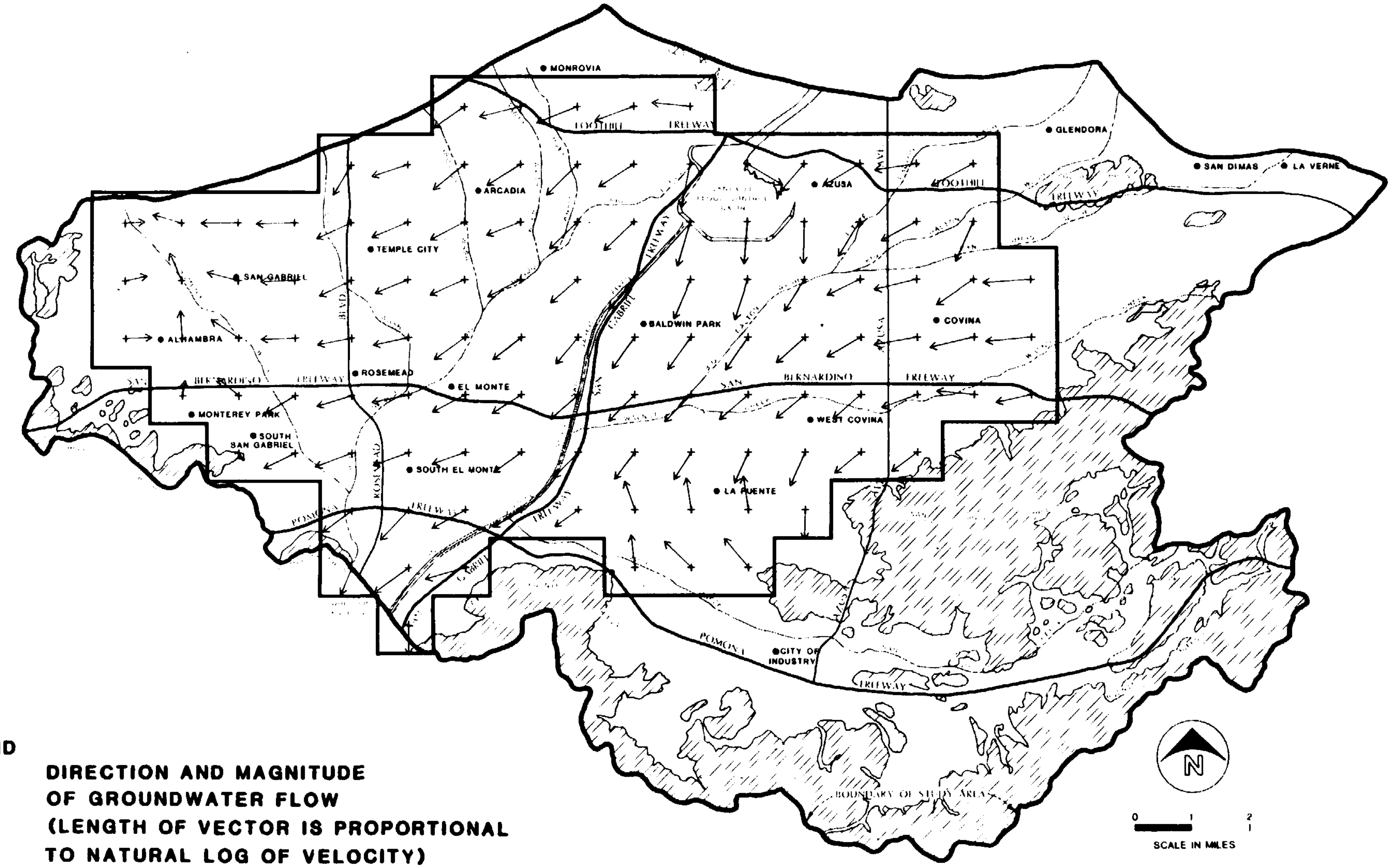
These comparisons of the observed water levels and calculated groundwater flow with the results of the three-dimensional numerical simulations indicate that the model reproduces the regional groundwater flow conditions, in terms of water levels and flow directions, in the San Gabriel Basin. On a local scale, however, discrepancies between the "real-world" and the regional groundwater flow simulation results may exist. However, the three-dimensional model simulations provide a better understanding of the regional hydrogeology and groundwater flow conditions in the basin, suitable for the applications described below.

One of the primary applications of the modeling results is the calculation of groundwater velocities. This application is important because of the lack of data on actual groundwater velocities: It is very difficult to actually measure groundwater velocity in the field. It is generally estimated as the product of the hydraulic conductivity and the hydraulic gradient divided by the effective porosity of the aquifer. One advantage of using the results of a calibrated groundwater flow model to accomplish this task is that the model integrates all of the available information, including estimates of hydraulic conductivity, specific yield, recharge, and groundwater pumping, in solving for the water levels. This assures that a consistent set of parameters is used. The resulting calculated groundwater velocity, like the parameters used in the calculation, is an average over a sizeable volume of the aquifer. If there are significant variations in hydraulic conductivity and/or effective porosity within this region, groundwater velocities will vary accordingly: Some of the water will move faster than the average, and some will move more slowly.

This variation of the velocity within an aquifer will cause contaminants moving with the groundwater to spread out and contribute to the phenomenon known as dispersion. The transport of contaminants in the subsurface is affected to varying degrees by the average groundwater velocity, and also dispersion, retardation, and degradation. The consideration of these latter three processes is beyond the scope of this study. However, the consideration of the average groundwater velocity is considered to be useful for the planning of the RI/FS activities.

The direction and magnitude of the horizontal components of the average groundwater velocity for each of the model cells in the upper layer have been calculated for each of the 27 seasons in the 6-3/4-year simulation period. Some seasonal variation of the groundwater flow field has been observed. However, an examination of these variations and a comparison with the average groundwater direction and velocities suggested by a series of water level maps from Fall 1950 to Fall 1982 led to the conclusion that a time-averaged flow field is appropriate for the preliminary evaluation of the continued spreading of contaminants in the subsurface. This average flow field has been determined by averaging the velocities and directions at each of the model cells for each of the 27 seasons in the model simulation period. Figure 3-10 shows this average flow field.

The directions of flow are consistent with the conceptual understanding of the basin hydrogeology. Groundwater enters the basin from the neighboring basins on the northwest, north, east, and southeast, and flows either toward major pumping centers or toward the Whittier Narrows to the southwest. Based on the model analysis, average groundwater velocities appear to range from less than 100 feet per year in the western portion of the basin, where hydraulic conductivity is




LEGEND

DIRECTION AND MAGNITUDE OF GROUNDWATER FLOW (LENGTH OF VECTOR IS PROPORTIONAL TO NATURAL LOG OF VELOCITY)

20 FT/YR

200 FT/YR

2000 FT/YR

EXTENT OF AQUIFER IN FINITE-DIFFERENCE MODEL

NONWATER-BEARING ROCK

FIGURE 3-10
TIME AVERAGED GROUNDWATER FLOW FIELD
SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM

relatively low, to over 1,000 feet per year in the eastern and north central portions of the basin, where hydraulic conductivity and hydraulic gradients are relatively high. Throughout most of the south central portion of the basin, the average velocity appears to range from about 100 to 500 feet per year.

Comparison of Figure 3-10 with the plumes of groundwater contamination (Plates 1 through 3) indicates a strong correlation between the shapes of the plumes and the average flow vectors. This suggests that (1) the model simulations are representative of regional groundwater flow in the basin and (2) the time-averaged flow field is fairly representative of transport of contaminants in the subsurface that has occurred.

An analysis has been performed to evaluate the effects of uncertainty in model parameters on groundwater velocities calculated from the modeling results. The average horizontal groundwater velocity in an area near the center of the basin, where contaminated groundwater is known to occur, serves as the basis for comparison. For the base case (i.e., the calibrated results), the groundwater velocity is approximately 200 feet per year in a southwestern direction. The velocity in this area was recalculated for several alternative simulations in which the values of various input parameters were varied one at a time. The sensitivity measure is taken to be the percent change in velocity per percent change in parameter:

$$S_p = (\Delta V/V)/(\Delta P/P) \qquad (3\text{-}1)$$

where
$\Delta V$ = change in velocity
$V$ = horizontal groundwater velocity
$\Delta P$ = change in parameter value
$P$ = initial parameter value

The sensitivity measures and estimates of the potential error in estimates of model parameters were used to estimate the level of uncertainty associated with calculations of velocity. The estimates of the potential error associated with a model parameter are based on hydrologic judgment, with consideration given to the source and level of accuracy of the basic data sets. These values and the resulting uncertainty in the calculated velocity are presented in Table 3-17. The level of uncertainty in the calculated velocity is presented in terms of percent and in terms of feet per year at the reference cell.

The estimates of the possible error of the model parameters, although based on engineering judgement, are nonetheless somewhat arbitrary. In addition, it must be remembered that the model parameters are representative of regionally-averaged hydrogeologic properties. As discussed previously, smaller scale deviations from these larger scale averages may be much larger than the values of $\delta_p$ listed in Table 3-17. For example, the hydraulic conductivity of a lens of coarse gravel may be orders of magnitude greater than the average hydraulic conductivity of a larger section of alluvium which includes the gravel lens. The actual groundwater velocity in that gravel lens may be orders of magnitude greater than the average groundwater velocity of the larger section of alluvium.

Similarly, because of the regional scale of the model analysis, small scale effects, such as a localized cone of depression around a pumping well, may not be apparent in either the modeling results or the basin-wide water levels maps prepared by LACFCD. The groundwater velocities calculated here must be evaluated in this light; they are representative of average groundwater velocities, averaged over a sizeable volume, and small scale variations from these averages may be significant.

Table 3-17
EFFECTS OF UNCERTAINTY IN ESTIMATES OF
MODEL PARAMETERS ON CALCULATED GROUNDWATER VELOCITY

| Model Parameter | Sensitivity Measure (Percent Change in Velocity per Percent Change in Parameter | Possible Error in Parameter Estimate, (Percent) | Uncertainty in Calculated Velocity | |
|---|---|---|---|---|
| | | | (Percent) | Ft/Yr at Reference Cell |
| Specific yield | -1.10 | 100 | 110 | 234 |
| Vertical distribution of hydraulic conductivity | -0.76 | 100 | 76 | 160 |
| Horizontal hydraulic conductivity | 0.26 | 100 | 26 | 56 |
| Boundary conductance | 0.14 | 100 | 14 | 30 |
| Recharge at spreading basins | 0.48 | 25 | 12 | 25 |
| Recharge from precipitation | 0.23 | 50 | 12 | 25 |
| Vertical anisotropy | -0.01 | 900 | 6 | 12 |
| Groundwater pumping | -0.18 | 10 | 2 | 4 |
| Horizontal anisotropy | -0.01 | 200 | 2 | 4 |

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Although the sensitivity of the calculated velocity to the various model parameters is likely to be highly variable spatially within the basin, the results presented in Table 3-17 provide a useful measure of the relative importance of the different parameters. The greatest degree of uncertainty in velocities appears to be associated with the specific yield (assumed to be equal to effective porosity) and the vertical distribution of hydraulic conductivity. The simulations indicate that if hydraulic conductivity decreases markedly with depth, a larger portion of the regional flow in the basin travels through the upper layer, thereby increasing groundwater velocities through this layer. Of intermediate importance to velocity calculations are estimates of boundary conductance and recharge. Potential errors in the estimates of groundwater pumping and anisotropy (hydraulic conductivity varying with direction) do not appear to significantly affect calculations of groundwater velocity in the reference portion of the model area.

Although there is a considerable margin of uncertainty in average groundwater velocities, the improvement obtained by utilizing the modeling and sensitivity analyses has also been considerable. The original analyses of the hydrogeologic properties of the basin led to estimates of hydraulic conductivity that were judged to be accurate to within an order of magnitude. However, the subsequent two- and three-dimensional modeling analyses and sensitivity analyses identified the possible ranges of the model parameters and examined the effects of these uncertainties. This approach has led to a better understanding of the modeling results. Moreover, based on the sensitivity results, areas of further data collection and refinement may be identified and prioritized. The parameters for which additional data acquisition and analysis would be the most beneficial, in terms of reduction of uncertainty in the modeling results, are:

- The areal distribution and magnitude of specific yield
- The horizontal and vertical distribution of hydraulic conductivity
- Recharge at spreading basins and from precipitation

### 3.2.4 APPLICATION OF MODELING RESULTS

The following analyses are based on groundwater movement estimated from the groundwater flow modeling results. Groundwater flow toward and away from areas of existing contamination is used to infer: 1) the potential location of source areas of contaminants, and 2) the potential spreading of contaminants. These analyses are somewhat simplified because they do not account for retardation, dispersion, mixing and dilution, and degradation of the contaminants. However, these analyses are considered useful for planning future RI/FS activities in the basin.

#### 3.2.4.1 Identification of Potential Contaminant Source Areas

The identification of areas that are potential sources of contamination is important to defining future remedial investigation activities and evaluating possible remedial action alternatives. This analysis has been undertaken using the results of the analysis of the flow field, based on model results; the available water quality data; and a semi-analytical mathematical model of groundwater transport. This mathematical model has been implemented in a computer code called RESSQ (Javandel et al., 1984). This model is valid for the case of two-dimensional steady-state flow in a isotropic and homogeneous porous media. The time-averaged flow field described above was assumed to be appropriate for the use of this model. In addition, retardation, dispersion, and contaminant degradation are neglected as discussed above. These simplifying assumptions are considered appropriate because the analysis is intended to provide only an initial assessment of potential source areas.

The model grid does not extend into the Puente Valley; therefore, groundwater flow estimates are not based on model simulations. In this area, groundwater flow estimates have been based on estimates of aquifer properties using data from wells and water level maps prepared by LACFCD as described above.

The RESSQ computer code was used to calculate the zone of capture of selected wells with contaminated groundwater for various time periods. The zone of capture is the region from which groundwater and, thus, contaminants would be extracted over a given time period. By determining the volume of aquifer that a given well may have obtained its water for different periods of time it may be possible to assess the location of the source of contamination. This information can be used with other information on potential sources to focus further investigations. The details of the zone of capture analysis are described in Appendix A.

A sensitivity analysis, based on estimates of uncertainty in the estimated parameter values, indicates that the calculated sizes of the zones of capture were about plus or minus 35 percent of the size based on the best estimates. In addition, departures of the actual groundwater flow field from the idealized two-dimensional uniform flow field for which RESSQ was developed, will alter the actual shape and size of the zone of capture. However, these factors were not included in this preliminary analysis.

Based on this analysis, potential source areas have been identified. These areas have been characterized as having either moderate or high probability of being source areas. This distinction has been based on the following criteria:

- Location in the groundwater flow field with respect to other calculated contaminant source areas

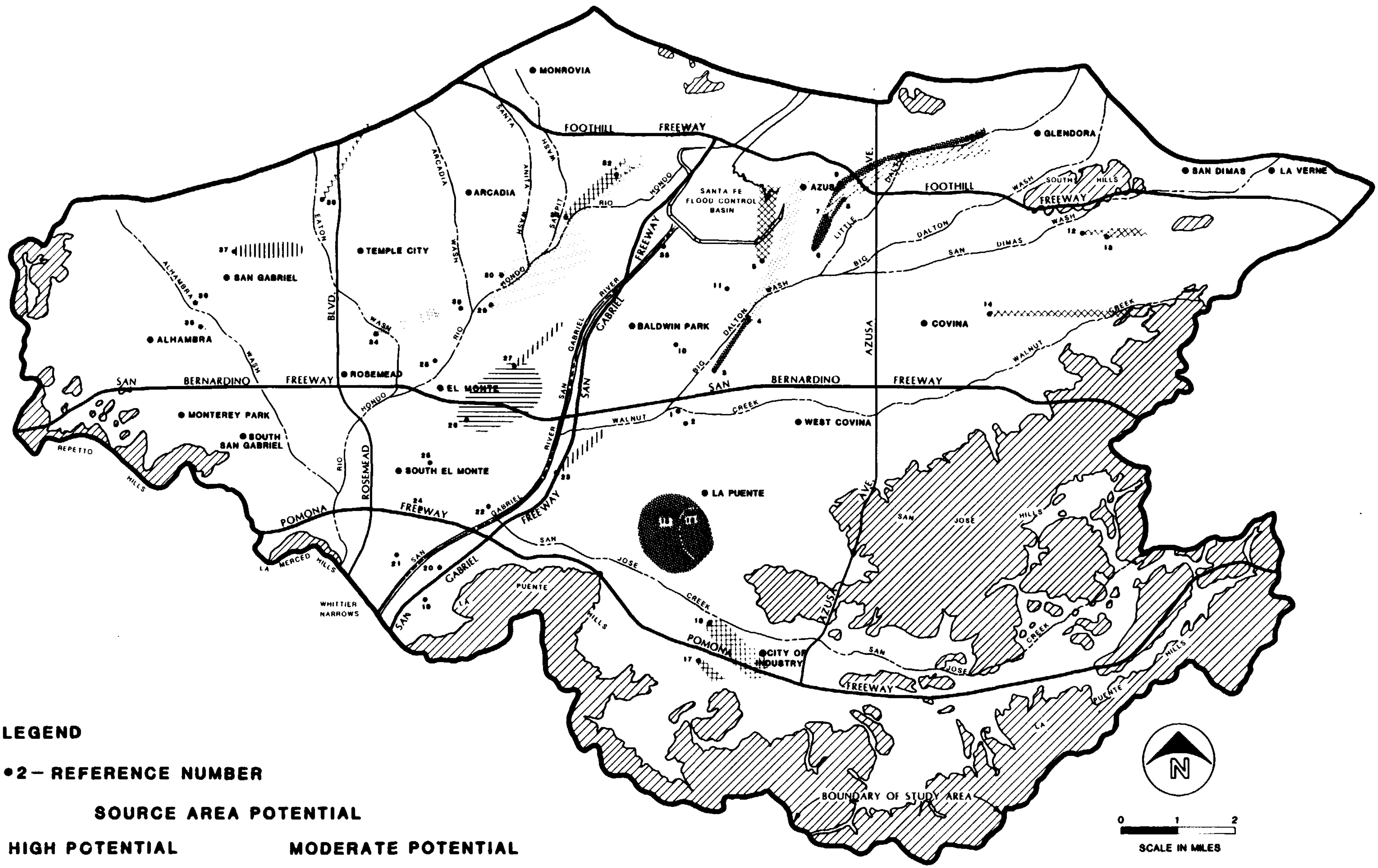
- Level of contamination in the downgradient wells

- Number of contaminated downgradient wells

- Temporal variations of levels of contamination in downgradient wells

The last criterion refers to wells with low or no detectable levels of contamination which have previously shown high levels of contamination. Such wells may be close to a source area that is no longer contributing contamination to the groundwater. Alternatively, this phenomenon may have been caused by a portion of a plume of contamination moving into the zone of capture of such a well. In either case, contamination may have moved downgradient; and a source area should be determined. The results of this analysis are shown in Figure 3-11.

Of particular interest are the source areas extending southwest (downgradient) from Azusa. It is possible that, if contaminants have been migrating for 30 to 40 years, sources in the Azusa area may be responsible for most downgradient contamination. It should also be noted that, based on the average flow directions and the zone of capture analyses, there are possibly two distinct sources of high level contamination in the Azusa area: sources associated with contamination in area No. 5 and source areas associated with the contamination in areas 6 through 9.




LEGEND

•2 – REFERENCE NUMBER

SOURCE AREA POTENTIAL

| HIGH POTENTIAL | MODERATE POTENTIAL |
| --- | --- |
| 2 OR MORE CONTAMINANTS | 2 OR MORE CONTAMINANTS |
| TCE | TCE |
| PCE | PCE |

NONWATER-BEARING ROCK

**FIGURE 3-11**
**INITIAL ASSESSMENT OF POTENTIAL SOURCE AREAS**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**

Given the simplifying assumptions used in this analysis, the calculated potential source regions should be considered as a first approximation or an initial assessment of possible source areas. However, this analysis is expected to be a useful tool when used in conjunction with an inventory of contaminants used or generated by industry in the area. The careful evaluation of the areas identified by this analysis may provide the additional information necessary to conduct a refined analysis. It may be appropriate to base the refined analysis on more sophisticated modeling techniques in order to better delineate potential sources.

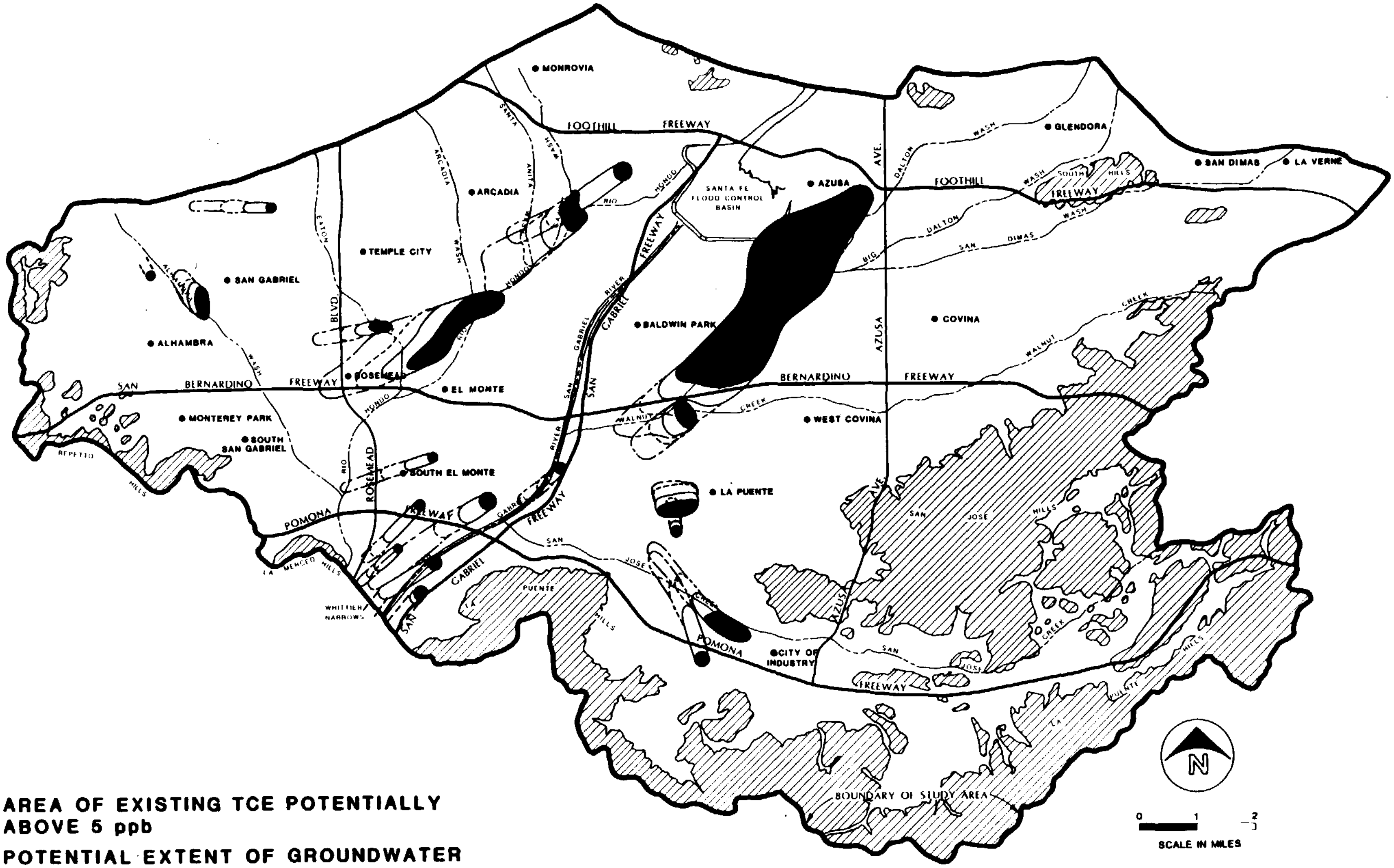
### 3.2.4.2 Potential Migration of Contaminants

If no remedial actions are undertaken to either contain or remove and treat the contaminated groundwater, the contamination will spread. An analysis was made to evaluate the potential movement of groundwater from areas contaminated with volatile organic compounds. The following analysis is based upon the results of the evaluation of the regional flow field in the basin. For this preliminary evaluation of the potential migration of contaminants, it was considered appropriate to base the analysis on an average groundwater flow field. For this initial evaluation, the mechanisms of dispersion, mixing and dilution, retardation, and contaminant degradation in the subsurface have been neglected to simplify the analysis at this stage in the investigation. Therefore, the dominant mechanism of subsurface spreading of contaminants is assumed to be advection due to groundwater flow. This analysis is considered adequate for use in planning the RI/FS at this phase of investigation. These other factors, which are potentially significant, will be considered in the RI/FS.

Based on the above assumptions, the extent of groundwater movement from areas of TCE contamination in excess of 5 ppb, PCE contamination in excess of 4 ppb, and CTC contamination in excess of 5 ppb (Plates 1, 2, and 3, respectively) has been determined for periods of 5, 10 and 20 years; although it should be noted that for the longer time periods, the uncertainties in the projections become more significant. The average groundwater velocities and flow directions shown in Figure 3-10 has been used except in the areas of the small plumes located just outside the model area in Puente Valley and near San Dimas. For these areas, groundwater velocities were calculated using hydrogeologic properties and an average gradient determined from LACFCD water level maps.

The projected extent of groundwater movement from areas contaminated with TCE, PCE, and CTC at levels greater than or equal to the action levels associated with these contaminants is shown in Figures 3-12 through 3-14, respectively. It is readily apparent from these figures that the potential for subsurface migration of these contaminants is significant. In areas where the groundwater velocity is great, the extent of groundwater movement and thus continued spreading of contaminants may be up to several miles in the next 5 to 20 years. In addition, what currently appears to be separate and distinct areas of contamination may merge, forming larger areas.

In this analysis, the upgradient extent of the areas of contamination has been assumed to remain stationary. This reflects the current uncertainty about the nature and locations of the sources of contamination. If there is an existing source contributing contaminants to the groundwater, as for example, contaminants in the unsaturated zone being periodically leached into the water table, or if contaminants are gradually being desorbed from the aquifer material, the upgradient extents of contamination may remain relatively stationary for some time. If this is the case, the size of the area of contamination may increase markedly, which may be inferred from Figures 3-12 through 3-14. However, if the




LEGEND

AREA OF EXISTING TCE POTENTIALLY ABOVE 5 ppb

POTENTIAL EXTENT OF GROUNDWATER MOVEMENT AFTER 5 YEARS

POTENTIAL EXTENT OF GROUNDWATER MOVEMENT AFTER 10 YEARS

POTENTIAL EXTENT OF GROUNDWATER MOVEMENT AFTER 20 YEARS

NONWATER-BEARING ROCK

## FIGURE 3-12

## POTENTIAL MOVEMENT OF GROUNDWATER FROM AREAS WITH EXISTING TCE CONTAMINATION

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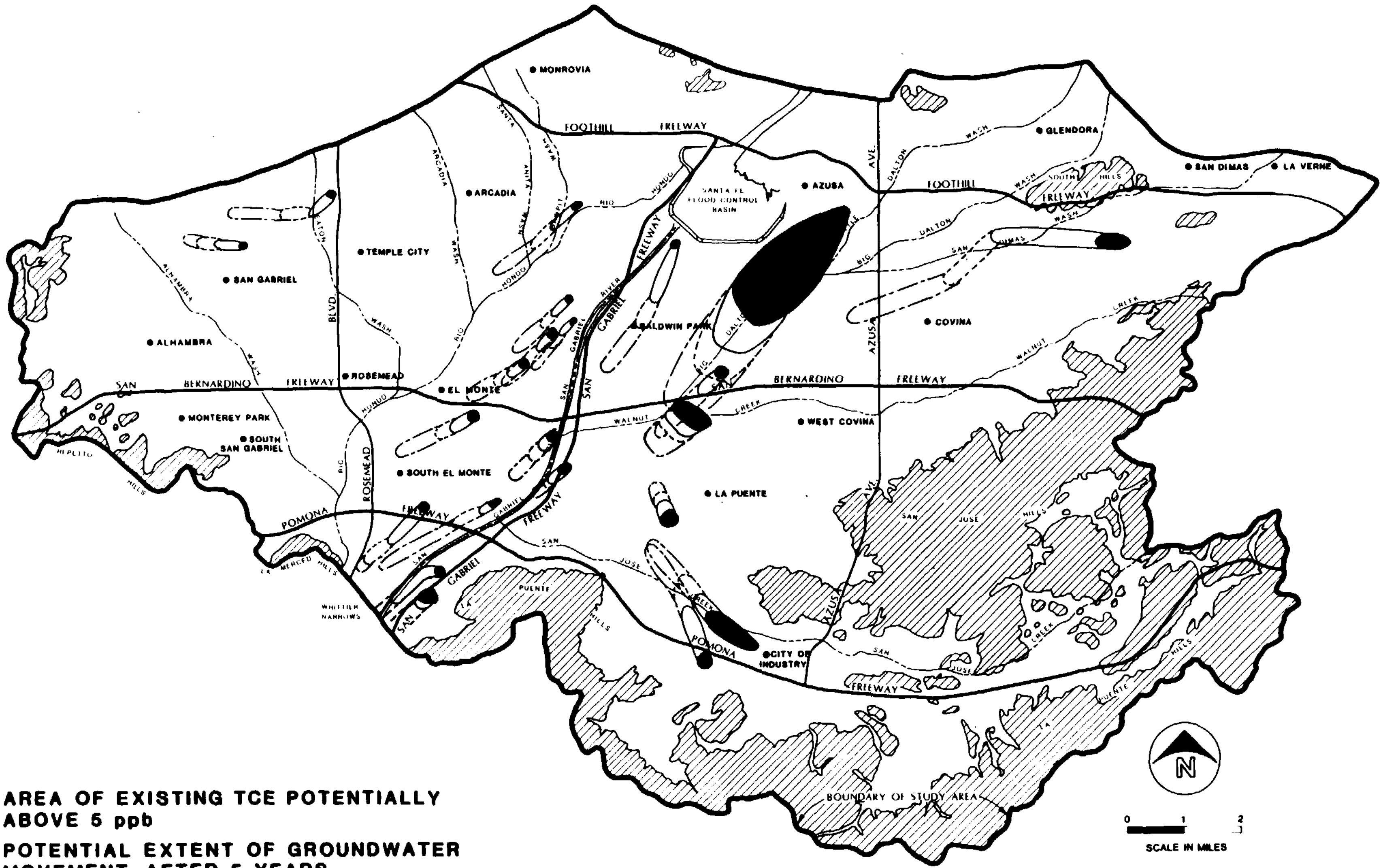



**LEGEND**

AREA OF EXISTING TCE POTENTIALLY ABOVE 5 ppb

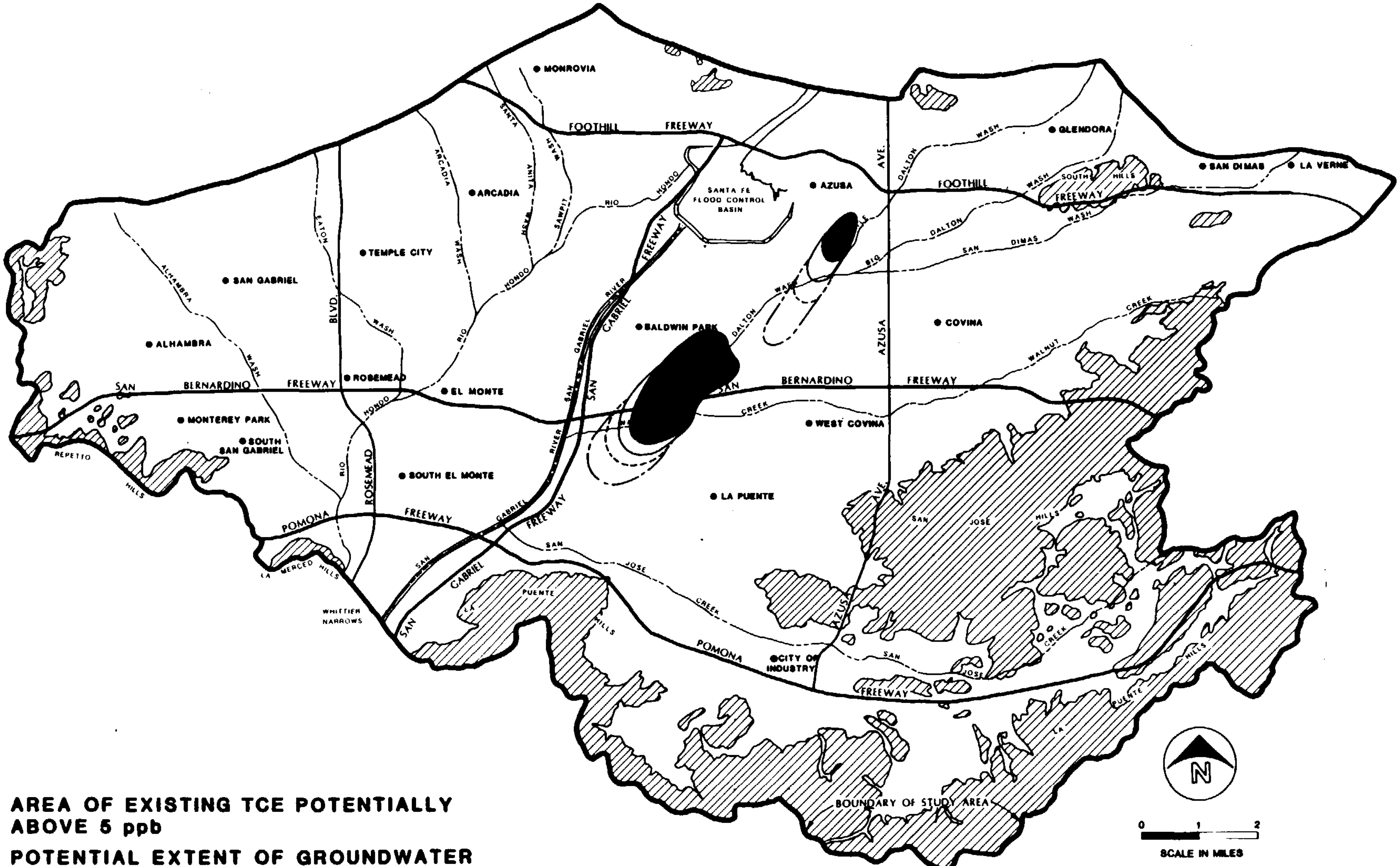
POTENTIAL EXTENT OF GROUNDWATER MOVEMENT AFTER 5 YEARS

POTENTIAL EXTENT OF GROUNDWATER MOVEMENT AFTER 10 YEARS

POTENTIAL EXTENT OF GROUNDWATER MOVEMENT AFTER 20 YEARS

NONWATER-BEARING ROCK

**FIGURE 3-13**
**POTENTIAL MOVEMENT OF GROUNDWATER FROM AREAS WITH EXISTING PCE CONTAMINATION**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**




**LEGEND**

AREA OF EXISTING TCE POTENTIALLY ABOVE 5 ppb

POTENTIAL EXTENT OF GROUNDWATER MOVEMENT AFTER 5 YEARS

POTENTIAL EXTENT OF GROUNDWATER MOVEMENT AFTER 10 YEARS

POTENTIAL EXTENT OF GROUNDWATER MOVEMENT AFTER 20 YEARS

NONWATER-BEARING ROCK

**FIGURE 3-14**

**POTENTIAL MOVEMENT OF GROUNDWATER FROM AREAS WITH EXISTING CTC CONTAMINATION**

**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**

existing areas of contamination are the result of previous contamination having reached the groundwater zone and are not receiving additional contamination from current sources, then, in the absence of sorbing-desorbing phenomena, the upgradient extent of contamination is likely to move downgradient. If this is the case, the size of the area of contamination may not increase as significantly. In addition, if the contaminants are subject to retardation or degradation in the subsurface, the potential spread of the contamination would be less than is inferred here. On the other hand, the effects of mechanical dispersion of contaminants in the subsurface, and local scale heterogeneities in the groundwater flow field, which have been neglected at this phase of the investigation, would tend to increase the spread of contamination, although potentially lower the average levels of contamination.

Further analysis will be required to more accurately predict the possible spread of contamination in the basin. A refined level of analysis, including an evaluation of the magnitude of the effects of retardation, degradation, and dispersion will be addressed in the later stages of the RI/FS. For this stage of the investigation, the analysis presented above is adequate to define potential problems and to focus future investigations.

LASG4/010

# 4.0

# INITIAL SCREENING OF NO-ACTION AND SURFACE WATER SUPPLY ALTERNATIVES

This section of the SSP presents an initial screening of two alternatives to address groundwater contamination in the San Gabriel Basin. These alternatives include: 1) the no-action alternative; that is, do nothing to address the contamination, and 2) an alternative which involves replacing contaminated groundwater with a surface water supply.

## 4.1 NO-ACTION ALTERNATIVE

Evaluation of the no-action alternative is conducted to establish a baseline condition against which other remedial action alternatives can be compared. The evaluation typically includes an endangerment assessment to identify potential effects on public health and the environment. Endangerment assessments are conducted in accordance with EPA's guidance document titled, "Draft Superfund Public Health Evaluation Manual." Development of an endangerment assessment for the San Gabriel Basin is beyond the scope of the San Gabriel SSP. The objectives of the no-action alternative evaluation in this initial screening effort are as follows:

- Identify contaminants for which existing federal standards and state guidelines have been exceeded
- Assess the extent of contamination
- Assess the potential effect on the future availability of a noncontaminated groundwater supply

## 4.1.1 IDENTIFICATION OF CONTAMINANTS EXCEEDING FEDERAL STANDARDS AND STATE GUIDELINES

For the purpose of the initial screening of the no-action alternative, the following water quality criteria and standards are used as an indication of the potential threat to public health and the environment: EPA proposed Maximum Contaminant Levels (MCL's), EPA Recommended Maximum Contaminant Levels (RMCL's), California Department of Health Services Action Levels, and Federal Water Quality Criteria for Drinking Water. These standards and criteria as defined as follows:

- EPA RMCL's are nonenforceable health goals which are set to concentration levels at which no known or anticipated adverse effects on public health occur. If a RMCL is promulgated for a particular chemical compound, then a MCL must be set as close to the RMCL as feasible, taking cost and other factors into consideration.

- Maximum Contaminant Levels (MCL's) for drinking water are federal water quality standards required by the Safe Drinking Water Act. MCL's are enforceable standards for organic, inorganic, and radiologic contaminants, which may have "any adverse effect upon the health of persons." Health effects, costs, and other factors are taken into consideration in setting MCL's. The EPA has recently proposed MCL's for many volatile organic compounds, which are expected to be finalized in late 1986.

- o California Department of Health Services Action Levels are recommended levels developed to protect public health. Action Levels are based on $10^{-6}$ incremental lifetime cancer risk levels for carcinogens, or acceptable daily intakes for noncarcinogens. Action Levels exist for both inorganic and organic contaminants. Action Levels for organic contaminants are frequently lower than MCL's, and a number of Action Levels for organics have been developed for Action Levels for which no MCL's exist.

- o Federal Water Quality Criteria for Drinking Water are provided for comparison of contaminant levels found in the San Gabriel Basin for which there are no RMCL's, MCL's, or State Action Levels. In this case, these criteria are provided for compounds which have been identified as noncarcinogenic. The noncarcinogenic values have been established by the EPA on the basis of a survey of the toxicology literature. Based on the lieterature survey and addition of a safety factor, levels were established which are considered to represent an acceptable daily intake.

Table 4-1 shows the published EPA proposed MCL's and RMCL's, Federal Water Quality Criteria for Drinking Water, and CDHS Action Levels for contaminants detected in the San Gabriel Basin. The maximum reported concentrations observed for the historical record of data are shown as well as the number of wells in which a given contaminant has been detected. The number of wells for which maximum historical observed concentrations has exceeded EPA proposed MCL's is shown to provide an indication of the extent of the potential health risk that may be posed by the contamination. As illustrated by Table 4-1, the contaminant which occurs in concentrations

Table 4-1

COMPARISON OF HISTORICAL GROUNDWATER CONSTITUENT CONCENTRATIONS TO STATE AND FEDERAL CRITERIA, STANDARDS AND GUIDELINES

| Chemical Parameter | Max. Historical Conc. ppb | No. Wells Exceeding EPA Proposed MCL's | No. Wells Compound Has Been Detected Historically | Safe Drinking Water Act Maximum Contaminant Limit (MCL)[a] | Recommended MCL (RMCL)[b] | CAL-DHS Action Level[c] | Federal Water Quality Criteria for Drinking Water[d] |
|---|---|---|---|---|---|---|---|
| **Volatile** | | | | | | | |
| 1,1,1-Trichloroethane | 170 | 0 | 21 | 200(P) | 200(F) | 200 | |
| 1,1-Dichloroethane | 8.5 | 0 | 4 | | | | |
| 1,1-Dichloroethylene | 96 | 5 | 25 | 7(P) | 7(F) | 6 | |
| 1,2-Dichloroethane | 8.4 | 2 | 7 | 5(P) | 0(F) | 1 | |
| Acetone | 100 | 0 | 1 | | | | |
| Carbon Tetrachloride | 48 | 11 | 54 | 5(P) | 0(F) | 5 | |
| Chloroform | 25 | 0 | 18 | 100[e] | | | |
| Methylene Chloride | 10 | 0 | 6 | | | 40 | |
| m,p-Xylene | 0.3 | 0 | 1 | | 440(P)[g] | 620[g] | |
| o-Xylene | 0.2 | 0 | 1 | | 440(P)[g] | 620[g] | |
| Perchloroethylene (Tetrachloroethylene) | 500 | 0 | 131 | | 0(P)[f] | 4 | |
| trans-1,2-dichloroethylene | 110 | 0 | 10 | | 70(P) | 16 | |
| Trichloroethylene | 1100 | 74 | 194 | 5(P) | 0(F) | 5 | |
| **Semivolatile** | | | | | | | |
| Bis(2-ethylhexyl)phthalate | 60 | 0 | 9 | | | | 21,000 |
| Di-n-Butylphthalate | 10 | 0 | 3 | | | | 44,000 |

NOTE: ALL CONCENTRATIONS IN PPB UNLESS OTHERWISE NOTED.

Table 4-1 (Continued)

| Chemical Parameter | Max. Historical Conc. ppb | No. Wells Exceeding EPA Proposed MCL's | No. Wells Compound Has Been Detected Historically | Safe Drinking Water Act Maximum Contaminant Limit (MCL)[a] | Recommended MCL (RMCL)[b] | CAL-DHS Action Level[c] | Federal Water Quality Criteria for Drinking Water[d] |
|---|---|---|---|---|---|---|---|
| Acid | | | | | | | |
| Phenol | 10 | 0 | 5 | | | 1 | |

[a]MCL's proposed 11/13/85 (Federal Register - Part III)
[b]RMCL's proposed 11/13/85 (Federal Register - Part IV); Final RMCL's effective 12/13/85.
[c]CAL-DHS, Sanitary Engineering Branch, Action Levels Recommended by DHS, March 1986.
[d]Draft Superfund Public health Evaluation Manual, ICF Incorporated, December 18, 1985.
[e]The standard for chloroform is established in the National Interim Primary Drinking Water Regulations.
[f]Perchloroethylene RMCL proposed 6/12/84 (Federal Register).
[g] Levels are for single isomer or for the total sum of the isomers.
P = Proposed
F = Final

LASG3/039

NOTE: ALL CONCENTRATIONS IN PPB UNLESS OTHERWISE NOTED.

above EPA proposed MCL's more than any other contaminant is TCE. TCE has exceeded proposed MCL's in 74 of the 254 wells tested in the San Gabriel Basin. Carbon Tetrachloride has exceeded EPA proposed MCL's in 11 wells. The EPA has not published a proposed MCL for PCE; however, PCE has exceeded the California State Action Level of 4 ppb in 56 wells. These numbers compare with the 1985 data for TCE, PCE, and CTC given in Table 3-14 as follows: 43, 28, and 9 wells, repectively. To date, however, water purveyors in the basin have been able to implement interim measures to reduce the contaminant levels below proposed MCL's and Action Levels in the water supply before distribution except for Rurban Homes and Richwood Mutual Water Companies as discussed in Section 1.0.

### 4.1.2 EXTENT OF CONTAMINANTS EXCEEDING FEDERAL STANDARDS AND STATE GUIDELINES

TCE is the most commonly occurring contaminant in the basin which exceeds both EPA proposed MCL's and State Action Levels. PCE is the second most common contaminant detected in the basin, followed by CTC. Section 3.1.4 describes the distribution of these contaminants; and Plates 1, 2 and 3, respectively, show the extent of these contaminants. Figure 3-3 in Section 3.1.4 shows the distribution of other contaminants in the basin which have exceeded EPA proposed MCL's and State Action Levels.

TCE contamination at levels potentially exceeding the EPA proposed MCL and State Action Level is spread over a minimum of approximately 6-1/2 square miles of the San Gabriel Basin as estimated from Plate 1. Similarly, PCE covers a minimum of approximately 3 square miles of the study area as shown in Plate 2. CTC contamination occurs over a minimum of approximately 2-1/2 square miles of the study area as determined from Plate 3. Detectable levels of these three contaminants occur over a much larger area.

### 4.1.3 POTENTIAL EFFECTS OF CONTINUED SPREADING OF CONTAMINANTS

The movement of groundwater from areas contaminated by TCE, PCE, and CTC has been described in Section 3.2.4.2. As indicated previously, Figures 3-12 through 3-14 can be used to assess the potential extent of contamination that may occur over the next 5 to 20 years. Potentially, the areal extent of contamination may increase significantly if the status quo is maintained in the San Gabriel Basin.

The potential effects associated with groundwater movement from contaminated areas on existing groundwater use in the San Gabriel Basin is identified in Table 4-2. This table lists the producers which historically have been or currently are affected by one or more contaminants exceeding EPA proposed MCL's or State Action Levels, the number of wells operated by a producer, the number of wells affected by historical contamination, and the number of wells which may potentially be affected as a result of groundwater movement from contaminated areas. As indicated in Table 4-2, of the 33 producers which have been affected, 88 wells have been impacted by contamination at some time in the past or are currently impacted; and 94 wells potentially may be affected over the next 5 to 20 years. In addition, twenty more groundwater users may be affected if the status quo is maintained in the basin.

Groundwater contamination in the San Gabriel Basin poses a potential public health threat as indicated by the following: the widespread occurrence of contaminants in the groundwater which exceed water quality standards defined by EPA proposed MCL's and State Action Levels; the widespread occurrence of these contaminants, which in many cases exceeds water quality standards by an order of magnitude or more; and groundwater movement from contaminated areas which can be expected to spread contamination further in the basin.

Table 4-2
SUMMARY OF WELLS HISTORICALLY AFFECTED AND POTENTIALLY AFFECTED BY GROUNDWATER CONTAMINATION

| | Number of Wells | Number of Historically Affected Wells | Number of Additional Wells Potentially Affected* |
|---|---|---|---|
| AZ-Two, Inc. | 1 | 1 | -- |
| Alhambra, City of | 12 | 4 | 3 |
| Arcadia, City of | 9 | 2 | -- |
| Azusa, City of | 8 | 1 | 1 |
| California American Water Company - Duarte System | 17 | 1 | -- |
| California American Water Company - San Marino System | 16 | 2 | 5 |
| City of Industry | 4 | 2 | 2 |
| Clayton Manufacturing Company | 1 | 1 | -- |
| Covina Irrigating Company | 6 | 3 | -- |
| Covina, City of | 3 | 1 | -- |
| Del Rio Mutual Water Company | 2 | 1 | 1 |
| El Monte, City of | 9 | 3 | 3 |
| Glendora, City of | 11 | 1 | -- |
| Hemlock Mutual Water Company | 2 | 2 | -- |
| La Puente Valley County Water District | 3 | 1 | 1 |
| Manning Brothers | 1 | 1 | -- |
| Monrovia, City of | 5 | 3 | 2 |
| Polopolus, et. al | 1 | 1 | -- |
| Richwood Mutual Water Company | 2 | 2 | -- |
| Rose Hills Memorial Park Association | 2 | 1 | 1 |
| Rurban Home Mutual Water Company | 2 | 2 | -- |
| San Gabriel County Water District | 7 | 1 | 2 |
| San Gabriel Valley Water Company | 39 | 15 | 9 |
| South Pasadena, City of | 4 | 1 | 2 |
| Southern California Water Company - San Gabriel | 22 | 9 | 6 |
| Southern California Water Company - San Dimas District | 14 | 2 | -- |
| Southwest Suburban Water Systems | 47 | 13 | 10 |
| Sunny Slope Water Company | 3 | 1 | 1 |
| Texaco, Inc. | 1 | 1 | -- |

[a] From Table 3-16. Note that this number includes wells which may have been taken out of services and wells which presently may have contaminated levels lower than EPA-proposed MCL's and State Action Levels.

* Based on groundwater movement from areas where TCE, PCE, and CTC is potentially at or exceeds EPA's MCL's and/or State Action Levels.

Table 4-2 (Continued)

| | Number of Wells | Number of Historically Affected Wells[a] | Number of Additional Wells Potentially Affected* |
|---|---|---|---|
| Tyler Nursery | 1 | 1 | -- |
| Valencia Heights Water Company | 5 | 1 | -- |
| Valley County Water District | 11 | 6 | 2 |
| Ward Duck Company | 2 | 1 | 1 |
| Subtotals | 273 | 88 | 52 |
| **Potentially Affected Water Users** | | | |
| Adams Ranch Mutual Water Company | 2 | -- | 2 |
| Amarillo Mutual | 2 | -- | 2 |
| California Domestic Water Co. | 8 | -- | 3 |
| Cedar Avenue Mutual | 2 | -- | 2 |
| Champion Mutual | 2 | -- | 2 |
| Conrock (California Portland Cement) | 3 | -- | 1 |
| Crown City Plating | 1 | -- | 1 |
| Driftwood Dairy | 1 | -- | 1 |
| Green, Walter | 2 | -- | 2 |
| H. Via | 1 | -- | 1 |
| Los Angeles, County of | 12 | -- | 4 |
| Owl Rock Products | 4 | -- | 1 |
| Rincon Ditch | 2 | -- | 2 |
| Rincon Irrigation Company | 2 | -- | 2 |
| San Gabriel County Club | 2 | -- | 2 |
| Southern California Edison | 5 | -- | 1 |
| Sterling Mutual | 2 | -- | 2 |
| Sunoco Products Company | 2 | -- | 2 |
| Valley View Mutual | 3 | -- | 3 |
| Whittier, City of | 6 | -- | 6 |
| Subtotals | 69 | | 42 |
| TOTALS | 342 | 88 | 94 |

[a] From Table 3-16. Note that this number includes wells which may have been taken out of services and wells which presently may have contaminated levels lower than EPA-proposed MCL's and State Action Levels.

* Based on groundwater movement from areas where TCE, PCE, and CTC is potentially at or exceeds EPA's MCL's and/or State Action Levels.

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Presently, all groundwater purveyors are able to provide a water supply which does not exceed EPA proposed MCL's or State Action Levels by blending contaminated water with non-contaminated water, taking contaminated wells out of service, or trying various treatment methods, except Richwood and Rurban Homes Mutual Water Companies in El Monte, for which the EPA is currently designing treatment systems as discussed in Section 1.0. Eventually, as the contamination continues to spread, it may be more difficult to develop a groundwater supply which will meet existing federal standards and state water quality guidelines. As it becomes more difficult to develop a noncontaminated groundwater supply, the potential for public exposure to contamination will increase. Therefore, a remedial investigation and feasibility study should be completed to identify and evaluate potential remedial action alternatives and allow the cost-effective alternative to be selected and implemented.

## 4.2 SURFACE WATER SUPPLY ALTERNATIVE

This section provides an initial evaluation of the alternative of replacing contaminated groundwater in the San Gabriel Basin with a surface water supply. This evaluation is not intended to replace the evaluation normally conducted in a feasibility study as defined by CERCLA. Alternative evaluations under CERCLA include the following analyses: technical, environmental, public health, institutional, and cost (U.S. EPA, 1984). A complete alternative evaluation based on these factors is beyond the scope of the SSP. The purpose of this evaluation is to provide a relative indication of the potential of using a surface water supply.

The evaluation of the surface water supply alternative consists of three parts, as follows:

- Identification of the groundwater production which contains contaminants above EPA proposed MCL's or State Action Levels
- Potential availability of a surface water supply
- Potential cost of the replacement water

## 4.2.1 GROUNDWATER PRODUCTION AFFECTED BY CONTAMINATION

The surface water and groundwater rights in the San Gabriel Basin were adjudicated in 1973 (Los Angeles County Superior Court Case No. 924128). As a result of that adjudication, records of groundwater production and surface water diversions in the San Gabriel Basin are maintained by the Main San Gabriel Basin Watermaster. The Main San Gabriel Basin Watermaster has published detailed records on groundwater production by producer on an annual basis since 1974. These records show quarterly production for the periods October through December, January through March, April through June, and July through September. These records have been analyzed to determine the average quarterly and annual production of wells for the period of record, 1974 through 1984. During this period, an annual average of 224,500 acre-feet of combined surface water and groundwater was produced in the basin. Of that amount, 209,400 acre-feet, or 93 percent of the water used in the basin, was groundwater.

The groundwater users' wells, which have been shown to exceed EPA proposed MCL's or State Action Levels at some time in the past, have been evaluated to assess the total production represented by their contaminated and noncontaminated wells.

Average annual groundwater production has been determined for: 1) those wells which historically have been reported to be contaminated, 2) all wells operated by the producer for the period of available record, and 3) the combined totals of the contaminated and noncontaminated wells.

The average historical annual groundwater production from wells which has been affected by contamination at some time in the past represents approximately 63,510 acre-feet. This contaminated groundwater production represents about 33 percent of the groundwater historically pumped from the basin by producers whose wells have been affected, or about 30 percent of the total groundwater production, and about 28 percent of the total water use in the basin. Similarly, 88 wells have been shown to be affected by contamination historically which represents 32 percent of the 273 wells operated by the affected producers. Note that these figures are based on historical groundwater production statistics and do not reflect the amount of groundwater pumped currently, because many contaminated wells have been taken out of production. As indicated previously in Table 4-2, an additional 94 wells potentially may be affected over the next 5 to 20 years.

### 4.2.2 POTENTIAL AVAILABILITY OF A SURFACE WATER SUPPLY

Existing sources of surface water supplies in the basin include existing surface waters, State Water Project water imported by the San Gabriel Valley Municipal Water District and water imported by the Metropolitan Water District of Southern California (MWD). The only potentially substantial new surface water supply in the San Gabriel Basin is the water imported by the MWD. As indicated previously, groundwater represents over 90 percent of the water supply in the basin; therefore, there is no other local supply large enough to meet the potential demand for replacement water. The MWD provides supplemental water to meet the demands of its 27 member agencies located in six counties in Southern California. The service areas of the MWD covers about 5,100 square miles, and includes 133 cities and 12.3 million people. This represents about half the population of the State of California (MWD, 1982).

In 1982 and 1983, the MWD published report Numbers 946 and 948, respectively, which presented an evaluation of water demand in the MWD service area and water supply available to the MWD, projected to the year 2000. The major conclusions drawn from these evaluations are:

1. There will be a significant increase in the water demands to be met by the MWD in the future.

2. The MWD's water supply will be much less dependable in the future than it has been in the past, and it will vary from year to year.

3. The people in the MWD's service area will remain highly dependent upon completion of the State Water Project to meet their needs for water, regardless of whatever else is done to reduce potential water shortages.

The MWD has developed projections of "normal" and "above-normal" water demands for their service area. The "normal" water demand projection represents water demands under conditions of most probable population growth and average weather conditions. The "above-normal" water demand projection represents the water demands that might occur under conditions of the most probable population growth, and of weather conditions that produce an above-normal level of water use, such as occurs in years characterized by low rainfall and above average temperatures (MWD, 1982).

The MWD's water supply consists of four general sources: Local Water Supply, Los Angeles Aqueduct Supply, Colorado River Supply, and the State Water Project Supply. The MWD has identified four factors which will determine the future availability of its water supply (MWD, 1983). These factors are:

1. The amount of precipitation and runoff in the basins from which the MWD receives its supply

2. The timing of the construction of new State project facilities for the conservation and transport of water

3. The effects of current and possible future litigation on MWD's water rights and water supply contracts

4. The need for additions to water distribution systems in Southern California

The MWD has developed estimates of water supply available based on assumptions regarding future water development and the resolution of legal issues, detailed in its report (MWD, 1983). Based on these assumptions, estimates of available supply were developed for three different hydrologic conditions:

1. Average year supply - supply available in years of average runoff

2. Dependable supply - the firm yield that is available over a prolonged dry period (a repeat of the 1928-34 hydrology)

3. Probable minimum supply - that available during a severe drought, such as 1976-77

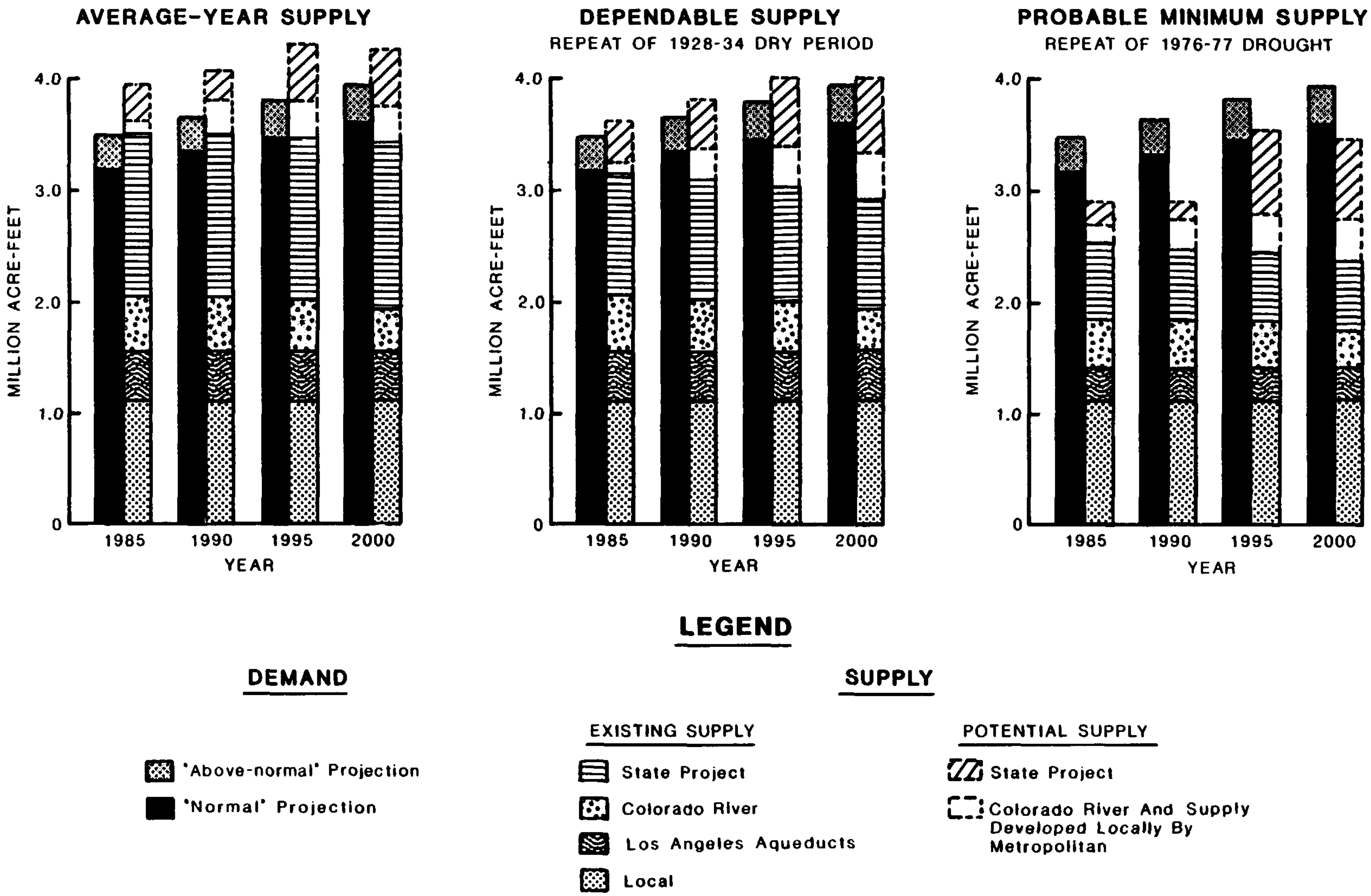
The projected normal and above-normal demands are compared with the average year, dependable, and probable minimum supplies from existing and potential new sources in Figure 4-1 (MWD, 1983). This figure shows that if potential new supplies are not developed, for an average year supply, above-normal demands will exceed existing supplies by 1990. For the case of dependable supply, the existing dependable supply was about equal to the normal projected demand for 1985, and would be exceeded by the projected normal demand for 1990 by over 200,000 acre-feet. Moreover, the projections for the probable minimum supply, even including potential additional supply, falls over 200,000 acre-feet short of the projected normal demand for 1985 and almost 400,000 acre-feet short for 1990. Expansions of the water supply are expected by MWD to allow normal and above-normal demands to be met during average and dependable supply conditions. Whether or not these potential supplies are attainable, however, is dependent on future determinations of the financial and political feasibility of proposed projects and the availability of funds for their implementation.

The potential for MWD to supply replacement water for contaminated groundwater appears unlikely as indicated by the above discussion. MWD has already projected a potential shortfall in meeting its projected demands. MWD's assumptions have not taken into consideration the occurrance of groundwater contamination, which may present additional demands for their supplies. The potential for MWD to provide replacement water on a small scale and for individual water purveyor situations will have to be evaluated in a more detailed feasibility study.

### 4.2.3 POTENTIAL COST OF REPLACEMENT WATER

The MWD currently provides untreated interruptible water to the San Gabriel Basin for groundwater recharge. This water

## Metropolitan Water District —
## Comparison of Water Supply with Demand




SOURCE: METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

**FIGURE 4-1**
**COMPARISON OF WATER SUPPLY WITH DEMAND**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**

was provided at a cost of $148 per acre-foot in fiscal year 1985-86. This cost is expected to be from two to four times the cost of pumping groundwater. For example, the Los Angeles Department of Water and Power (1983) indicated that their pumping costs for groundwater in the San Fernando Valley, to the west of San Gabriel Valley, were approximately $30 per acre-foot in 1982. If the total annaul groundwater production, representing that which has been affected historically (63,510 ac-ft) was replaced with MWD water at $148 per acre-foot, the total annual cost in 1985 dollars would be approximately $9.4 million.

The MWD has several prices for water depending on the category of water purchased. If a treated, noninterruptible supply of water is required, the 1985-86 fiscal year price was $224 per acre-foot. For 63,510 acre-feet, the total cost of replacement water would represent approximately $14.2 million per year. Projected water rates for MWD treated, uninterruptible water are shown in Figure 4-2. This figure indicates that MWD's rates are expected to escalate at 10 percent per year over the next 5 years.

Another factor which will affect the cost of replacement water is the need to construct additional distribution facilities. Presently, there are 17 service connections to the MWD system in the San Gabriel Valley. These service connections are used (or owned) by the following: Southern California Water Company, South Pasadena, the Upper San Gabriel Valley Municipal Water District, City of Covina, City of Glendora, City of West Covina, City of Alhambra, City of Arcadia, City of Monrovia, Azusa Valley Water Company, Valley County Water District, Los Angeles Flood Control District, and Central and West Basin Water Replenishment District. These service connections represent only 9 of the 53 presently or potentially affected producers in the basin. The level

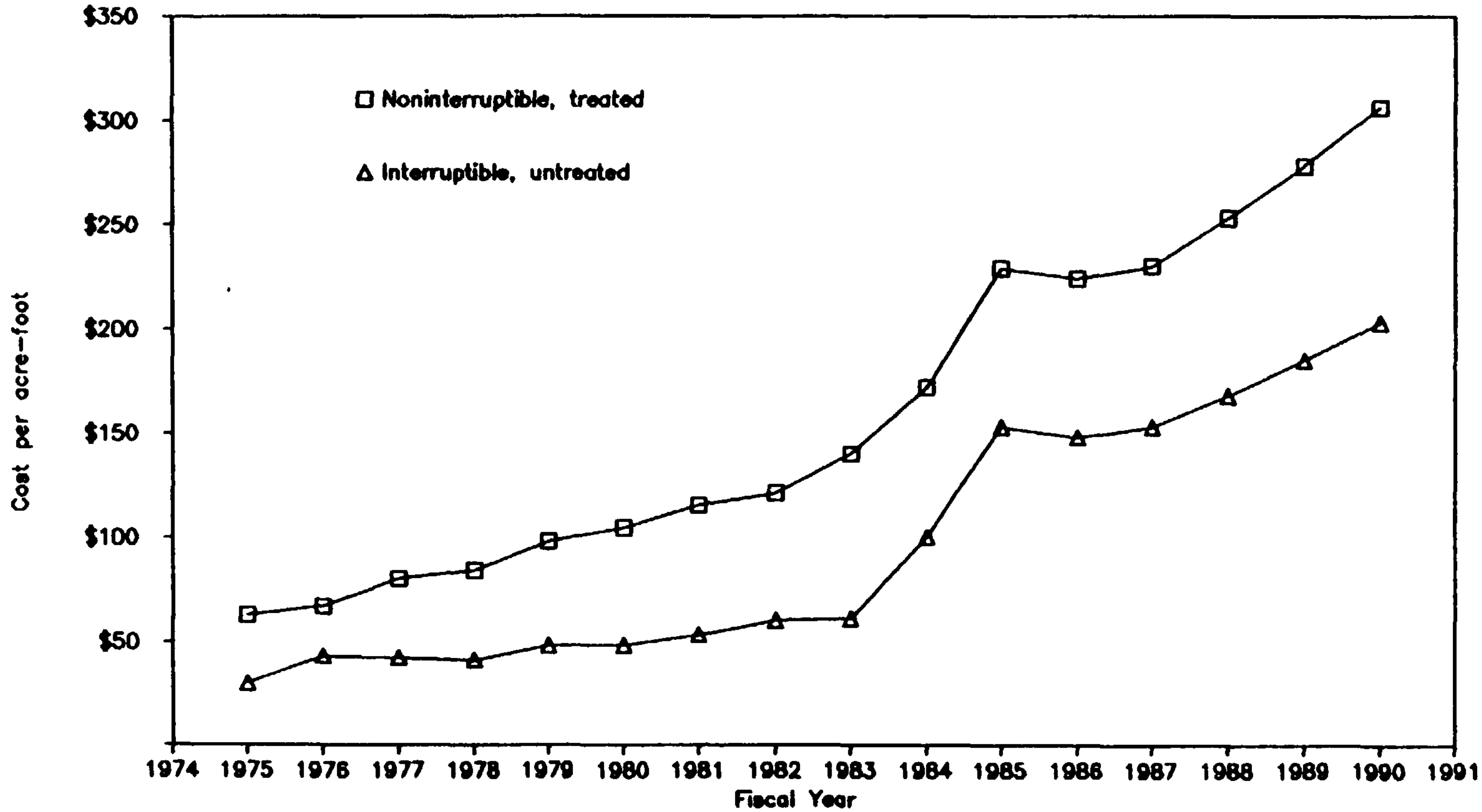



**FIGURE 4-2**
**HISTORICAL AND PROJECTED COST OF MWD WATER**
**SAN GABRIEL SUPPLEMENTAL SAMPLING PROGRAM**

of effort required to evaluate the feasibility and cost associated with connecting to the MWD system is beyond the scope of this investigation. These costs are expected to be high enough to warrant a feasibility study of other alternatives, however, in order to identify the most cost-effective alternative.

In summary, groundwater represents over 90 percent of the water supply in the San Gabriel Basin. More than 30 percent of the historical groundwater production in the San Gabriel Basin has been contaminated at some time in the past with compounds for which their EPA proposed MCL's or State Action Levels have been exceeded. Approximately 32 percent of the groundwater production wells of these affected producers are currently or have been contaminated and potentially another 94 wells may be affected by contamination in the next 5 to 20 years if the status quo is maintained. The only potential source of surface water supply of this proportion is the MWD. This potential water supply is uncertain because of projected water demands in Southern California and the uncertainty of developing additional water supplies. The annual cost of replacing groundwater production representing historically affected groundwater with an interruptible untreated MWD supply is approximately $9.4 million in 1985 dollars. If a treated, uninterruptible water supply is required, then the cost would be approximately $14.2 million per year. These costs do not include the substantial capital costs that would be required to construct distribution facilities which would be required to get the water supply to affected producers nor do they take into consideration the spread of contamination. The cost of MWD water is anticipated to escalate at a rate of approximately 10 percent per year over the next 5 years. Therefore, a remedial investigation and feasibility study should be completed to identify and evaluate potential remedial action alternatives and allow the cost-effective alternative to be selected and implemented.

# 5.0
# RECOMMENDATIONS

The San Gabriel Supplemental Sampling Program (SSP) has been successful in providing a better understanding of the organic contamination of groundwater in the basin. However, significant data gaps remain to be addressed in identifying parties responsible for the contamination and in identifying and developing cost-effective remedial actions. The SSP has developed a good data base from which to conduct a detailed RI/FS and specifically has provided the following:

- A centralized data base on geologic and hydrogeologic conditions in the basin that are pertinent to the analysis of remedial action alternatives

- A computerized data base on groundwater contaminant data and wells which will aid in the storage, retrieval, analysis, and display of these data during the RI/FS

- Further definition of the extent of TCE, PCE, and CTC contamination in areas of previously known or suspected contamination

- A better delineation of the types of other contaminants in the groundwater, in addition to TCE, PCE, and CTC, including primarily 1,1-DCE, 1,2-DCA, 1,1,1-TCA, and other volatile and semivolatile organic compounds

- An understanding of groundwater movement in the basin through the development of a three-dimensional groundwater flow model for the basin. This groundwater flow model will provide the foundation for further analysis of groundwater flow conditions in the identification of source areas and development of remedial action alternatives

- A preliminary identification of potential source areas of groundwater contamination

- A preliminary evaluation of the potential for contaminants to spread

- An initial assessment of public health effects from taking no action in mitigating the groundwater contamination including collection of hydrogeologic data in the areas of contamination, which indicates that existing groundwater contamination and further spread of this contamination poses a public health threat

- An initial assessment of replacing contaminated groundwater with a surface water supply, which indicates that other alternatives should be evaluated

Recommendations for further response to the groundwater contamination problem and areas to be addressed in an RI/FS are provided with regard to the following: monitoring, contaminant source investigation, further delineation of the extent of contamination including collection of hydrogeologic data in these areas, and identification and screening of remedial action alternatives. Each of these topics is discussed in the following subsections.

## 5.1 MONITORING

Contaminant levels exceeding MCL's or State Action Levels have been found in many areas of the basin. Groundwater production in these areas should be monitored on a continuous basis to assure that the public is not exposed to these contaminant levels. The CDHS Sanitary Engineering Branch in Los Angeles currently has a monitoring program for this purpose, which should be continued. The maps prepared to show the extent of TCE, PCE, and CTC, Plates 1, 2, and 3, respectively, should be used as a guide to identify groundwater production which potentially contains unacceptable levels of contaminants (i.e., concentrations exceeding EPA proposed MCL's and State Action Levels).

Groundwater production wells located downgradient of contaminated areas should be monitored on a regular basis. The maps showing the potential migration of TCE, PCE, and CTC, Figures 3-13, 3-14, and 3-15, respectively, can be used as a guide in the identification of potentially affected wells. Refinements in defining the rate and direction of contaminant migration may be necessary in some areas depending upon the degree of early warning needed, which is expected to relate to the availability of alternate water supplies. One possible monitoring scheme is to identify groups of wells which are located approximately the same migration route distance downgradient of a contaminated area, and have approximately the same perforated intervals. A key well representing this group of wells should be monitored on at least a monthly basis. Once contamination is detected in this key well, then monitoring would be initiated on a continuous basis in all of the wells in the associated group to assure that contaminants are not distributed in the public water supply systems above EPA proposed MCL's.

Key wells should be selected throughout the basin to provide a record of variations in contaminant concentrations. These wells should be located in areas containing high levels of contamination as well as areas containing no detectable contamination.

## 5.2 SOURCE INVESTIGATIONS

A very approximate analysis has been conducted to identify areas containing potential sources of contamination. The results of this analysis should be overlayed with the EPA's results of data gathering activities on industries having used or disposed of the various types of contaminants found in the groundwater. The common geographical areas identified by these two results should be prioritized and evaluated further to support potential enforcement actions. These evaluations should include the following:

- o Conduct contaminant migration analysis to further address the assumptions employed in the analysis of potential source areas as described in Section 3.2.4.1. Contaminant migration analyses may assist in further prioritizing field data collection activities.

- o Collect field data to support the analytical activities and to make further determinations with regard to suspected source areas

The areas in the vicinity of Azusa should be given highest priority in the source investigations due to the levels of contaminants found in this area and the potential for continued spread of contaminants from this area. In addition, potential sources located in areas designated by the CDWR (1966) as nonwater-bearing formations should be evaluated to assess their potential for contributing to the contamination of the basin.

## 5.3 EXTENT OF CONTAMINATION

The areal extent of previously known or suspected areas of contamination have been better defined as a result of the sampling programs which were conducted in 1985. This sampling also identified additional types of contaminants and other areas of contamination which require delineation for development of remedial actions. Most importantly, the vertical extent of contamination must be better understood before cost-effective remedial action measures can be identified.

Many additional areas of TCE, PCE, and CTC contamination have been identified. The exact areal extents of these contaminants, however, are not known; and there are very few wells in the areas that can be used to adequately delineate the extent of contamination. These areas are summarized for the three common contaminants of TCE, PCE, and CTC as follows (see Plates 1, 2, and 3, respectively).

### TCE CONTAMINATION

- Areas east of the San Gabriel River:
  - Area just south of the South Hills
  - Areas at the confluence of the Puente and San Gabriel Valleys
  - The southern and eastern extent of the large area just east of the San Gabriel River
  - Small area just southwest of the large contaminated area

- Areas west of the San Gabriel River
  - North part of the northern most contaminated area
  - Numerous contaminated areas which are generally identified by one or two wells
- Area located in the Whittier Narrows

PCE CONTAMINATION

- Areas East of the San Gabriel River
  - Area just south of the South Hills
  - Area at the confluence of the Puente and San Gabriel Valleys
  - The southern and eastern extent of the large area just east of the San Gabriel River
  - The small area just west of the large contaminated area
- Areas west of the San Gabriel River
  - Numerous contaminated areas defined by one to two wells
- Area located in the Whittier Narrows

CTC CONTAMINATION

- The western, southwestern, and eastern part of the large contaminated area

- Areas west of the San Gabriel River which are defined by one or two wells

Many of these areas do not have existing wells which can be sampled to delineate the extent of contamination. New monitoring wells will have to be drilled to determine the extent of contamination. Because of the expense of new monitoring wells, further analysis of contaminant migration using contaminant transport models on a local basis should be conducted to delineate the probable extent of contamination based on potential sources of contamination and the duration that the contaminants may have been migrating. Remote sensing techniques such as soil gas sampling should be evaluated as to their potential for aiding in the delineation of contamination. New monitoring wells should be installed as necessary to confirm the extent of contamination identified by the analytical and remote sensing techniques.

The vertical extent of contamination is expected to be determined by the drilling of clusters of new monitoring wells, with each cluster defining the variation in contaminant concentrations with depth. As indicated by the results of the SSP, contamination may occur at depths in excess of 1,000 feet. The installation of cluster well sets are very expensive; therefore, consideration should be given to evaluating techniques such as spinner logging and depth sampling in existing wells. Spinner logs are used to measure the water velocity in the well bore, which provides an indication of the primary groundwater producing zones.

Spinner logging surveys will provide an indication of the depth intervals which contribute most to the water production of the well. This information will assist in delineating: 1) more permeable zones which may act a preferential pathways of contaminant migration and, 2) less permeable zones which may act to retard contaminant migration. Depth sampling in existing wells may provide an indication of the depth intervals which are most contaminated. In addition, further analytical work, such as contaminant transport modeling, may be conducted in the vicinity of potential source areas to evaluate the migration of contaminants to deeper parts of the basin. New monitoring well cluster sites should be installed at selected locations to confirm the variation of contaminant concentrations with depth.

## 5.4 IDENTIFICATION AND SCREENING OF REMEDIAL ACTION ALTERNATIVES

The selection and application of remedial action alternatives for responding to groundwater contamination in the San Gabriel Basin is expected to be multifaceted for the following reasons:

- Widespread extent of contamination

- Widespread variation in contaminant levels

- Variation in types of contamination

- Complexity of groundwater flow conditions and variations throughout the basin

- Potential degree of threat to public health and environment at any one time or place within the basin; i.e., some water producers have no alternative water supply to provide when their wells become contaminated

- Level of understanding with regard to the hydrogeology, type and extent of contamination, and applicability of potential remedial action alternatives; i.e., in some areas it may be possible to evaluate cost-effective remedial action alternatives based on existing information

- Potential for responsible party involvement in addressing certain areas of groundwater contamination

- Institutional complexities in developing remedial action alternatives which involve cooperation of many water producers to effect a remedial action

Because the remedial action of the groundwater contamination is expected to be multifaceted, consideration should be given to the following for the various areas of contamination: 1) establishing remedial response objectives with regard to public health and the environment; 2) identifying remedial action alternatives which are potentially feasible; 3) screening these remedial actions with regard to environmental protection, environmental effects, technical feasibility, institutional feasibility and cost; and 4) developing acceptable remedial action alternatives, including collection of additional data, as required to support a Record of Decision and selection of a final alternative.

In initiating remedial action evaluations, highest priority should be given to the following:

- Areas containing high levels of contamination which are contributing to the continued spread of contamination. Such areas include contamination near Azusa and just east of the Santa Fe Flood Control Basin, contamination north of El Monte and northwest of Rosemead, contamination at the confluence of Puente and San Gabriel Valleys, and contamination in the Whittier Narrows.

- Areas where the only water supply available to a producer providing drinking water to the public is contaminated above acceptable federal and state levels, or is threatened by the movement of contaminants

It is possible that interim actions may be required if water supply wells become contaminated and 1) the contamination cannot be dealt with easily by the producer and 2) there is no alternative supply available to the producer.

A workplan for the remaining portion of the RI/FS will be developed over the next several months. This workplan will identify those tasks necessary to address the above recommendations.

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# 6.0
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